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ENGINEERING EVALUATION TO EXAMINE AIR POLLUTION CONTROL TECHNOLOGY USED IN FOREIGN PRACTICE OF STEELMAKING

by

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16. ABSTRACT
The report gives results of a study to determine if technology used to capture and control fugitive dust emissions in the foreign practice of steelmaking is superior to that in use domestically. Where apparently superior technology was identified, a feasibility study was performed to show the technology's domestic applicability. Roof-mounted electrostatic precipitators (REPs) were identified as potentially superior technology. Using engineering data from an existing U.S. basic oxygen furnace shop and engineering design details for a Japanese-supplied REP, costs of retrofitting the technology to an existing plant were estimated along with energy consumption, building modifications necessary, utility and wastewater treatment needs, and expected performance. A visible emissions evaluation program was conducted in a Japanese steelmaking plant to determine the effectiveness of REPs in capturing and controlling fugitive emissions. REP electrical performance data obtained during this program and dust characteristics data from three fugitive dust sources in steelmaking operations were input to an electrostatic precipitator (ESP) computer model, and estimated performance was calculated. Good agreement was obtained between the actual measured performance of the REP and the computer-predicted performance for the source where the evaluation program was performed.

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ABSTRACT

A study was conducted to determine if technology used to capture and control fugitive dust emissions in the foreign practice of steelmaking is superior to that in use domestically. The foreign technology was compared to that in use domestically. Where apparently superior technology was identified, a feasibility study was performed to show the technology's domestic applicability.

Specifically, roof-mounted electrostatic precipitators (REP) were identified as potentially superior technology. Using engineering data from an existing U.S. basic oxygen furnace shop and engineering design details for a Japanese supplied REP, the costs of retrofitting the technology to an existing plant were estimated along with energy consumption, building modifications necessary, utility and wastewater treatment needs, and expected performance.

A visible emissions evaluation program was conducted in a Japanese steelmaking plant to determine the effectiveness of REPs in capturing and controlling fugitive emissions. REP electrical performance data obtained during this program and dust characteristics data from three fugitive dust sources in steelmaking operations were input to an electrostatic precipitator computer model and estimated performance was calculated. Good agreement was obtained between the actual measured performance of the REP and the computer predicted performance for the source where the evaluation program was performed.

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The last section of this report on use of a computer model to predict roof-mounted electrostatic precipitator performance was incorporated at the suggestion of the EPA Project Officers. Though not part of the scope of work, we believe it lends credibility to the argument for broad applicability of these devices. The modeling work was performed and reported by Leslie E. Sparks of the Particulate Technology Branch at the Air and Energy Engineering Research Laboratory in Research Triangle Park, North Carolina.

1.0 INTRODUCTION

The purpose of this project was to perform an engineering evaluation of fugitive emission control technology in use in Japan and Western Europe, and where judged to be superior to domestic technology show the foreign technology's applicability to domestic steelmaking practice. In evaluating foreign technology, emphasis was to be given to technology applicable to basic oxygen furnace (BOF) steelmaking. Following identification of apparently superior technology, on-site test programs to measure control effectiveness were planned for two sites.

Evaluation of both foreign and domestic technology was performed on data gathered via literature search and plant visits. Five plants were visited in Western Europe and twelve plants in Japan. Comparisons of technology and performance were made between three recently constructed U.S. BOF shops, and the foreign facilities. On the basis of these comparisons only one foreign technology offers substantial performance effectiveness improvement with significantly reduced energy consumption. That technology is roof-mounted electrostatic precipitators (REP). Two other technologies were identified as offering some improvement in capture and control effectiveness when applied to a specific furnace type or a furnace enclosure. They are an automatic sampling lance (which eliminates the need to turndown a BOF vessel to get a metal sample) and compressed air curtains (to prevent leakage from viewing ports in a furnace enclosure).

A feasibility study was performed to determine the applicability of REPs to existing domestic BOF fugitive dust sources. Among the factors considered in the feasibility study were changes needed to existing plant facilities, estimated cost to modify the old facilities and add the new equipment, and the expected performance of the REPs.

Due to difficulties in securing permission to test in foreign facilities the on-site performance evaluation was made in only one plant. The desired site for evaluation was a BOF shop with REPs. Permission to test in BOF shops could not be obtained from the plants' owners. A visible emissions performance evaluation was finally arranged in an electric arc furnace steelmaking shop with an REP.

Data obtained during the performance evaluation was used in conjunction with an electrostatic precipitator computer model to predict performance of REPs on other fugitive dust sources in iron and steelmaking.

2.0 SUMMARY AND CONCLUSIONS

The two categories of systems for BOF secondary emissions capture and control seen in the foreign plants were based on

1) local hooding only, and
2) local hooding plus partial building evacuation.

Plants with only local hooding predominated the plants visited. In respect to the performance or capture capability of the local hooding applications, the best systems observed captured virtually all of the secondary emissions. The method of estimating capture efficiency was subjective, but best performance for all secondary emission sources was in the range of 90 to 100 percent capture.

While the partial building evacuation systems for furnace emissions were not in the majority, there are several situations in which such installations may offer advantages over the use of only local hooding. In particular, the use of roof-mounted ESPs with no fans or minimal fan assistance, and therefore no significant air moving - pressure drop-energy costs, may be a cost effective alternative to complete reliance on local hooding connected to fabric filters.

The particulate collection device in most common use for secondary emission control systems is the fabric filter. Scrubbers and ESPs were used in only a few of the plants visited.

Based on performance observations and design data, the Italsider Taranto Works and Nippon Steel Yawata Works were selected as the plants with the best overall secondary emission control systems for top blown furnaces in Western Europe and Japan, respectively.

A comparison of visible emissions evaluation data and engineering design data for the Kaiser Steel Fontana BOF shop (a new U. S. plant completed in 1978 with similar control systems) with data obtained during visits to the Italsider Taranto Works and the Nippon Steel Yawata Works suggests the technology in use in these plants is equivalent.

The only foreign bottom blown facility visited was the Kawasaki Steel Chiba Works. Comparison of hood capture effectiveness estimates for furnace secondary emissions between the Chiba Works and Republic Steel's Q-BOP at South Chicago indicates the Japanese plant capture is at least as good or better. Given that furnace emissions escaping capture at the Chiba Works furnace enclosure are further subject to capture in the REPs, the implication is that overall effectiveness is better at the Chiba Works than at Republic Steel.

No REPs are in use in the U.S. A feasibility study was conducted on the applicability of the technology to a typical U.S. BOF shop. For a typical facility which contains two BOF furnaces of 273 tonne (300 ton) capacity each, the estimated cost, delivered and erected on site is $3,020,000 or 60 percent of the estimated project cost. The remaining costs are absorbed primarily by structural reinforcement and modification of the existing BOF building. The total estimated project cost is $5,010,000. Estimated annual operating costs are $654,000. All costs are estimated in third quarter 1982 dollars.

The existing BOF building chosen for study would require extensive bracing and reinforcement to sustain the loads imposed by the precipitators, primarily against wind loads at right angles to the building aisles. A computer analysis was performed on the existing BOF building. At crosswind speeds of 100 mph, drift of the structure may be a problem which requires further structural analysis.

The critical phase of furnace operation with respect to REP performance is hot metal charging. Using emission factors and several assumptions, the inlet concentration during hot metal charging is estimated as 0.96 gram/acm (0.42 grain/acf) giving an estimated outlet concentration of 0.082 gram/acm (0.036 grain/acf) where only one precipitator receives the fumes. The range of concentrations estimated to produce 20 percent opacity at the REP discharge is 0.112 to 0.222 gram/acm (0.049 to 0.097 grain/acf). Therefore, it appears the REP installation is capable of achieving discharges of less than 20 percent opacity during hot metal charging. A number of assumptions were necessary to make these performance estimates. It is important to verify the validity of some of these assumptions prior to proceeding with an installation.

A visible emissions performance evaluation was made on an REP applied to a Japanese electric arc furnace steelmaking shop. The visible emissions performance data showed 95 percent of the six-minute average opacities were 6% or less, with less than 1 percent of the averages exceeding 10% opacity. This performance is relatively good, but not quite as good as required for compliance with the proposed NSPS for EAF building discharges i.e., no reading exceeding 6% opacity. Analysis and comparison of the Japanese furnace operating practices to U.S. practice suggests that the Tokyo Steel practice provides a greater potential for fugitive emissions and, therefore, represents a more difficult control situation than would be typical of a U.S. plant at present. Operator training, revisions to the furnace offtake duct design, and adequate operating practice information at the time of precipitator design are potential means for improving the roof-mounted precipitator performance.

Subsequent to the visible emissions performance evaluation at the Japanese EAF plant, a study was undertaken to determine the applicability of the EPA/Southern Research Institute computer model of electrostatic precipitation to the REP. REP electrical data and EAF dust characteristics data were used as model inputs, and REP efficiency and stack opacities were computed. The computer model predictions were in good agreement with previously measured performance. Performance predictions were made for other steel plant sources using dust characteristic data appropriate for those sources.

The results show that the ESP computer model can usefully be used to investigate ESPs applied to industries other than coal-fired boilers. The model study suggests that an REP can be equally effectively applied to BOF fugitive emissions and blast furnace casthouse fugitive emissions. Additional tests of the model for various sources in the iron and steel industry are necessary to provide the same level of confidence in the model as exists in the utility industry. Such tests should include measurement of in-situ electrical resistivity and simultaneous measurement of inlet and outlet particulate size distribution and mass loading.

3.0 DISCUSSION OF FOREIGN TECHNOLOGY

The fugitive or secondary emission sources of interest in this study were those from basic oxygen furnace (BOF) charging and tapping, hot metal transfer, desulfurization of iron in torpedo cars or ladles, hot metal skimming, deslagging of torpedo cars or ladles, deskulling of ladles, and furnace puffing in the case of BOF suppressed combustion primary fume control systems. To provide some perspective the discussion begins with U.S. technology.

3.1 U.S. TECHNOLOGY PERSPECTIVE

At the time this project was begun in 1977, there were virtually no plants in the United States that had attempted to capture emissions from all or almost all of the above sources. A few plants had installed control systems for capturing furnace charging, puffing, and tapping emissions. Others had installed only hot metal transfer emission control systems. Since 1977, the number of U.S. plants with some furnace secondary emission control has increased to more than ten. However, only a few plants (perhaps three) have installed more complete secondary emission control systems, i.e., including such things as hot metal transfer, deslagging and deskulling, and desulfurization.

About half of the U.S. plants now controlling furnace secondary emissions use complete furnace enclosures and auxiliary charging hoods (auxiliary hood meaning other than the primary control hood). The remainder of the plants controlling furnace secondary emissions use their open hood primary systems along with partial furnace enclosures and modified operating practices, canopy hoods over the charging aisle, partial building evacuation, or combinations of the above to achieve capture and control. Other fugitive emissions from hot metal transfer, desulfurization, etc., are captured and controlled by local hoods.

The capture effectiveness of the systems in the U.S. varies widely. Recent work on revision of BOF New Source Performance Standards to include standards for control of fugitive BOF sources selects only three plants as having demonstrated best available technology. One of those plants, Kaiser Steel at Fontana, California, uses a furnace enclosure with charging and tapping hoods to control secondary furnace emissions from its closed hood, top blown furnaces. The Kaiser plant also controls hot metal transfer and skimming emissions with local hoods connected to the same fabric filter serving the charging and tapping hoods. The other two plants having best available technology for furnace secondary emissions use partial furnace enclosures (two or three sides), modified operating practices, and their large open hood primary control systems. These plants are Bethlehem Steel at Bethlehem, Pennsylvania, and Jones and Laughlin Steel (now LTV Steel) at Aliquippa, Pennsylvania. To date, no plants in the U.S. have been identified as having best available technology for capture and control of hot metal desulfurization and torpedo car or ladle deslagging.

3.2 FOREIGN TECHNOLOGY OVERVIEW

The foreign plants selected for visits were chosen on the basis of reports in the technical literature, vendor experience lists, trip reports from previous EPA foreign plant visits, and discussions with knowledgeable visitors from foreign countries. The five plants selected in Western Europe were as follows:

British Steel - Lackenby Works
Krupp - Rheinhausen Works
Hoogovens - Ijmuiden, Netherlands
Swedish Steel - Oxelosunds, Sweden
Italsider - Taranto Works

The above plants were visited in March of 1979. Seven Japanese steel plants were visited in September and October of 1979. They were as follows:

Nippon Steel - Oita Works
Nippon Steel - Yawata Works
Sumitomo Metal Industries - Kashima Works

Kawasaki Steel - Chiba Works
Kawasaki Steel - Mizushima Works
Kobe Steel - Kakogawa Works
Nippon Kokan - Ohgishima Works

Table 3-1 provides a general description of the emission control technology in each plant. The two basic approaches used for secondary furnace emission control are furnace enclosures with local hooding and local hooding plus partial building evacuation. Figure 3-1 shows a schematic flow diagram of a local hooding secondary system connected to a fabric filter. Figure 3-2 shows a plant arrangement in which a roof-mounted wet ESP is used for passive partial building evacuation.

Only one of the plants, however, chose to combine local hooding and partial building evacuation in the initial construction of the plant. The Chiba Works of Kawasaki Steel did include passive partial building evacuation through a roof-mounted wet ESP in the construction of their Q-BOP shop. All the other plants have retrofit the partial building evacuation systems, presumably due to ineffectiveness of their local hoods alone and changing environmental requirements. Capture of non-furnace secondary emissions was achieved in most plants by local hoods at the fume source. In some cases these emissions were ducted to control devices shared with the furnace secondary emissions while in other plants the non-furnace secondary emissions were sent to separate control devices.

Two plants were identified as having some secondary emission capture for torpedo car slag and kish (condensed carbon particles), and hot metal transfer in separate, small, enclosed buildings. Figure 3-3 shows an example. The basic design principles involved for these, however, are closer to local hooding than building evacuation.

As is evident from Table 3-1, the control device of choice for secondary emissions is the fabric filter with a few exceptions. One of the exceptions arises through the use of a Baumco design that processes charging emission waste gas through the primary fume scrubber. This system is best adapted to shops with larger vessels where the primary fume control systems have larger design gas flows needed for control of charging emissions. While the obvious advantage of this arrangement is the reduction of air flow needed in a separate

TABLE 3-1. Foreign Secondary Emission Controls

	Emission Control Technology	
Company/Plant	Secondary Furnace Emissions	Hot Metal Transfer, Desulfurization, Deslagging, Etc.
British Steel, Lackenby	Furnace Enclosure, Local Hoods + Canopy hoods - Scrubbers	Local Hoods - Scrubbers
Krupp, Rheinhausen	Furnace Enclosure, Local Hoods - Scrubbers	Local Hoods - Scrubbers
Hoogovens, Ijmuiden Plant No. 2	Furnace Enclosure, Local Hoods - Fabric Filter	Local Hoods - Fabric Filter & Scrubber
Swedish Steel, Oxelosund	Furnace Enclosure, Local Hoods - Fabric Filter	Local Hoods - Fabric Filter
Italsider, Taranto Plant No. 2	Furnace Enclosure, Local Hoods - Fabric Filter	Local Hoods - Fabric Filter
Nippon Steel, Oita	Furnace Enclosure, Local Hoods - Fabric Filter	Local Hoods - Fabric Filter
Nippon Steel, Yawata Plant No. 3	Furnace Enclosure, Local Hoods - Fabric Filter	Local Hoods + Enclosed Building Evacuation - Fabric Filter
Sumitomo, Kashima Plant No. 2	Partial Furnace Enclosure, Local Hoods + Partial Building Evacuation Fabric Filter	Local Hoods - Fabric Filter
Kawasaki, Chiba Plant No. 3	Furnace Enclosure, Local Hoods - Fabric Filter, Partial Building Evacuation Roof Wet ESP	Local Hoods - Fabric Filter

TABLE 1. (continued)

Company/Plant	Emission Control Technology Secondary Furnace Emissions	 Hot Metal Transfer, Desulfurization, Deslagging, Etc.
Kawasaki, Mizushima Plant No. 1	Partial Furnace Enclosure, Local Hoods - Fabric Filter Partial Building Evacuation to Roof Wet ESP	Local Hoods - Fabric Filter
Plant No. 2	Partial Furnace Enclosure, Local Hoods - Fabric Filter	Local Hoods - Fabric Filter
Kobe, Kakogawa	Partial Furnace Enclosure, Local Hoods - Fabric Filter	Local Hoods - Fabric Filter
Nippon Kokan, Ohgishima	Partial Furnace Enclosure, Local Hoods - Fabric Filter	Local Hoods - Fabric Filter

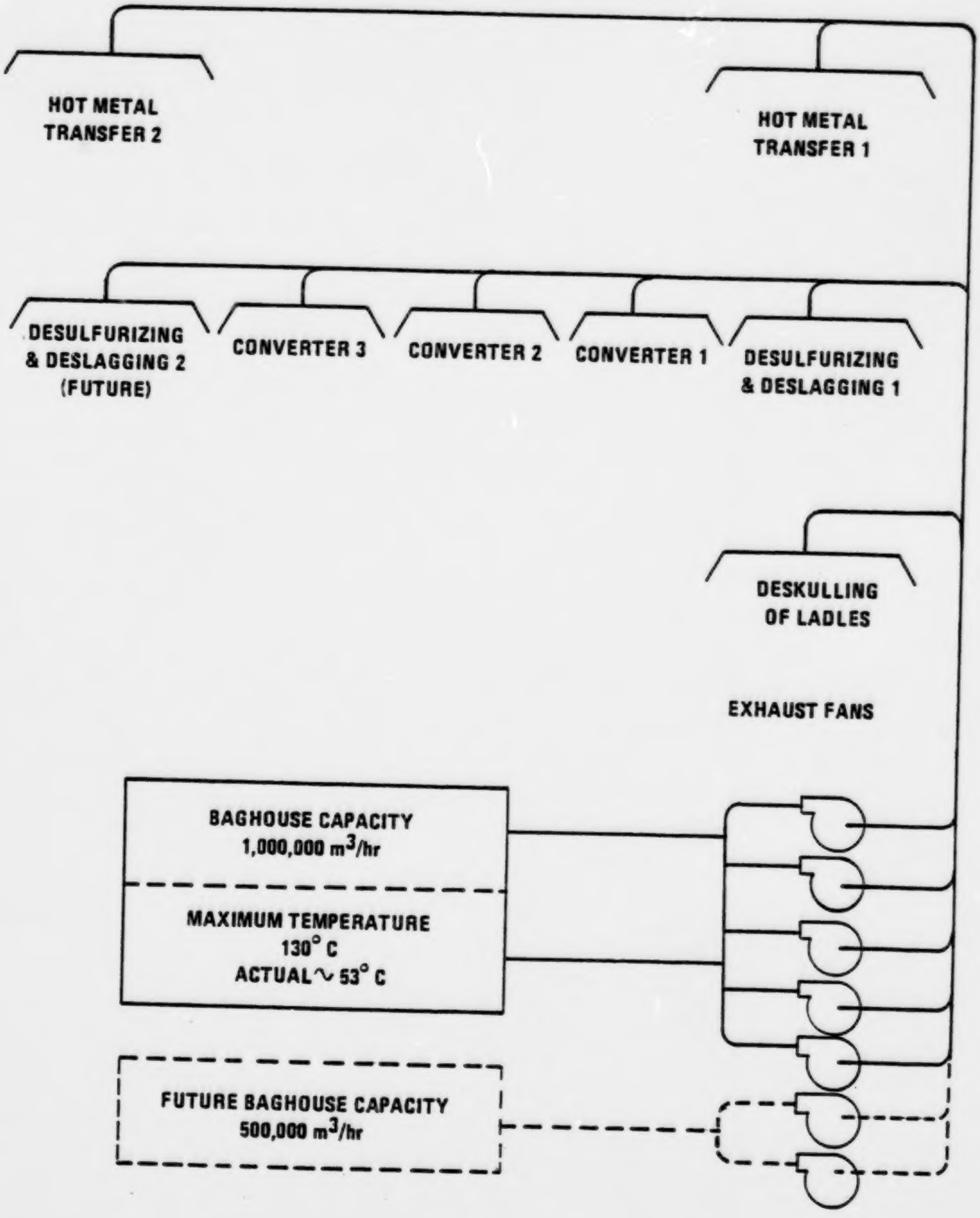

HOT METAL
TRANSFER 2
HOT METAL
TRANSFER 1
DESULFURIZING
& DESLAGGING 2
(FUTURE)
CONVERTER 3
CONVERTER 2
CONVERTER 1
DESULFURIZING
& DESLAGGING 1
DESKULLING
OF LADLES
EXHAUST FANS
BAGHOUSE CAPACITY
1,000,000 m3/hr
MAXIMUM TEMPERATURE
130° C
ACTUAL ∼ 53° C
FUTURE BAGHOUSE CAPACITY
500,000 m3/hr

Figure 3-1. Italsider-Taranto basic oxygen steelmaking secondary ventilation system.

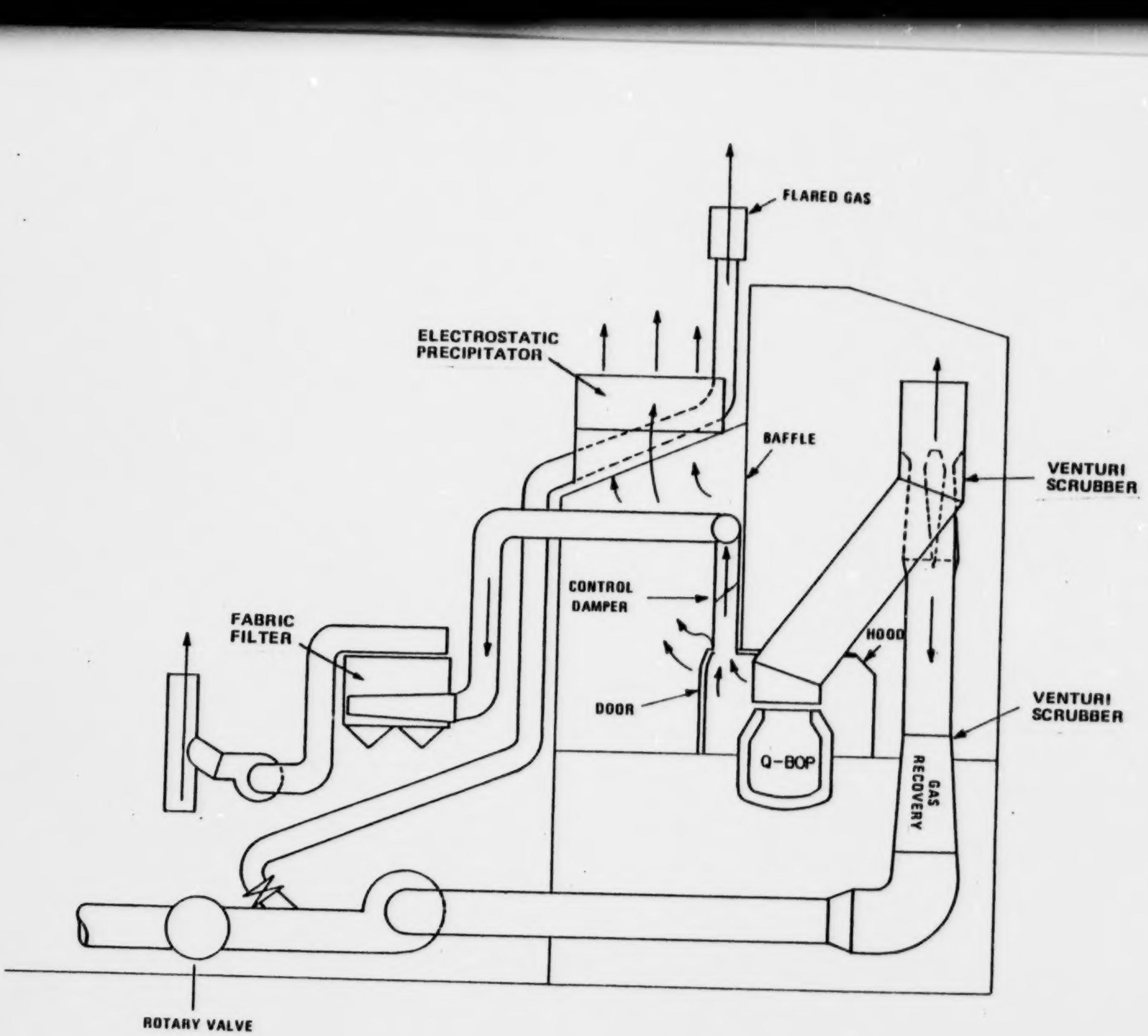

FLARED GAS
ELECTROSTATIC PRECIPITATOR
BAFFLE
VENTURI SCRUBBER
CONTROL DAMPER
FABRIC FILTER
HOOD
DOOR
VENTURI SCRUBBER
Q-BOP
GAS RECOVERY
ROTARY VALVE

Figure 3-2. Elevation of OG Gas Recovery and Dust Collection System, Q-BOP Plant, Kawasaki—Chiba.

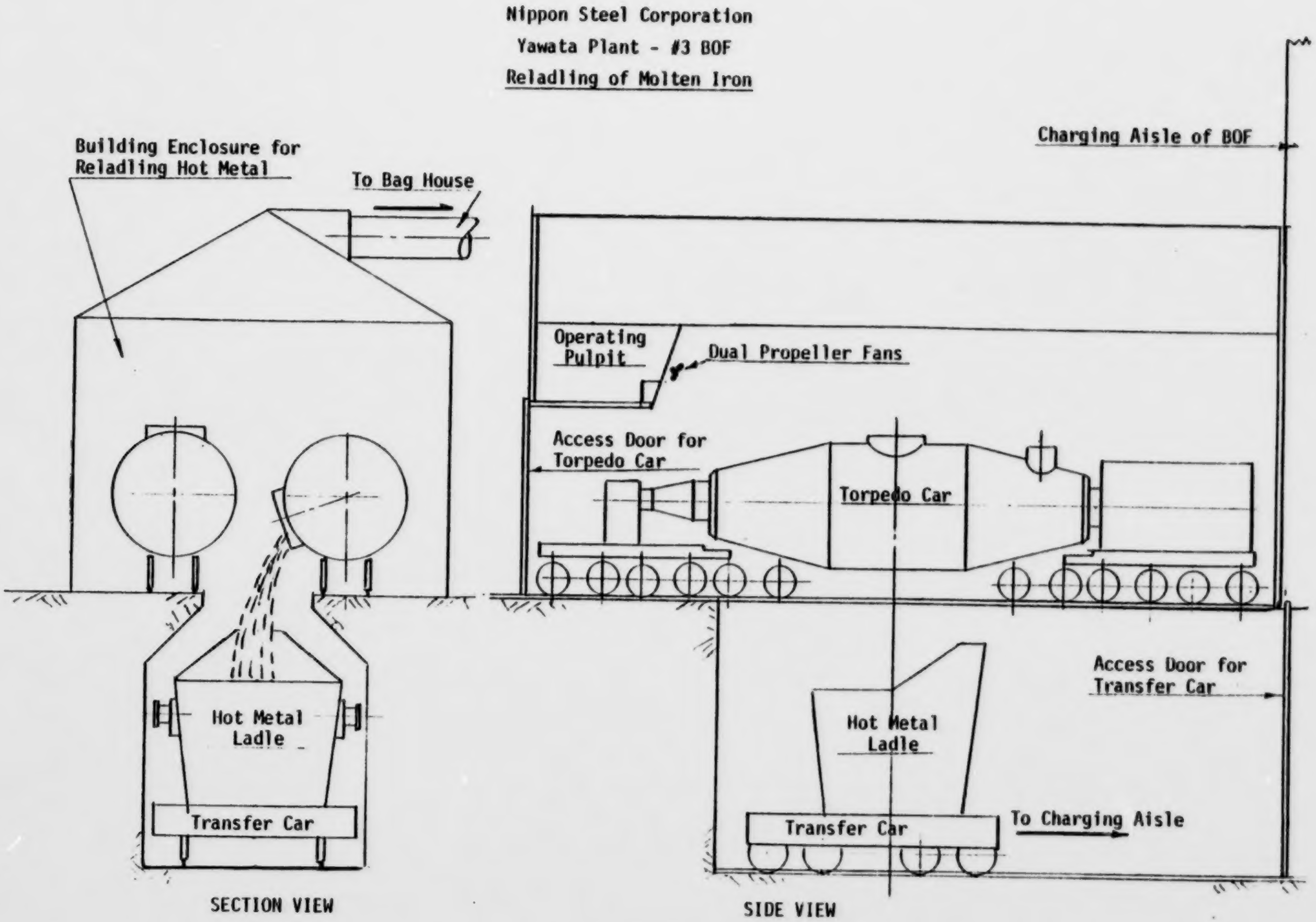

Nippon Steel Corporation
Yawata Plant - #3 BOF
Reladling of Molten Iron
Building Enclosure for Reladling Hot Metal
To Bag House
Charging Aisle of BOF
Operating Pulpit
Dual Propeller Fans
Access Door for Torpedo Car
Torpedo Car
Hot Metal Ladle
Transfer Car
Access Door for Transfer Car
Hot Metal Ladle
Transfer Car
To Charging Aisle
SECTION VIEW
SIDE VIEW

FIGURE 3-3. Enclosed building for torpedo car deslagging and dekishing and hot metal transfer.

secondary emissions control system, the disadvantage may be poor control of charging emissions depending on scrap quality and the limited primary gas flow available especially for closed hood furnaces. When charging emissions are treated as part of a larger secondary emission control system, it is possible to divert gas flow from other secondary operations long enough to ensure good control of heavy fuming charges.

Another exception to the fabric filter choice is the roof-mounted wet ESPs in use in Japan for partial building evacuation. The particular design in use in the plants visited in 1979 has no air moving equipment attached to it. Air movement through them is generated strictly by thermal drafts induced by fugitive process heat. The principal advantage of such a system is, therefore, reduced energy consumption because fan power to move waste gas through a fabric filter is eliminated. There are other factors that must be weighed against this advantage such as reinforcement of building structure to take the additional roof load, and wastewater treatment. The wastewater treatment consequence is probably not significant since most recently constructed BOFs use scrubbers for primary fume control and will have wastewater treatment facilities.

The choice between furnace emission control strictly by furnace enclosure and local hooding, or in combination with partial building evacuation is expected to vary with the particular site conditions. For instance, Q-BOP charging may present more difficulty in achieving good charging fume control by local hoods because of the necessity for blowing gas through the tuyeres when the vessel is turned down. In this case partial building evacuation might be a better choice. Heavy fuming produced by dirty scrap might also provide the incentive for partial building evacuation. In retrofitting an additional furnace vessel to an existing shop with inadequate space for good local hooding and ducting, partial building evacuation could supplement a less efficient local hood system.

The advantage, in general, of using local hooding instead of partial building evacuation is that air volumes treated are smaller and hence energy consumption is lower. The partial building evacuation system without an air mover may be an exception.

3.3 SELECTION OF PLANTS FOR DETAILED DESCRIPTION

In all of the foreign plants visited, performance observations were made on the secondary emission control systems. The principal effort was to visually evaluate the capture capabilities of the various local hoods. Where partial building evacuation was used, building emissions were observed. Since there is no standard method for visual determination of capture, the performance estimates are subjective. A further limitation of the performance observations is that the total observation time in each plant was restricted by the visit schedule and in some cases by time limits established by the host plant management. For these reasons, the performance observation period varied between one and five furnace cycles. The best performing technology observed for each of the secondary sources provided virtually complete capture of the fumes with capture efficiencies estimated in the range of 90 to 100 percent. These estimates must be combined with process conditions to relate the system performance to typical United States plant conditions.

All of the BOF shops visited in Western Europe had top blown furnaces, with some open hood and some closed hood waste gas systems. On the basis of subjective performance estimates and review of the system design and plant operations in Western Europe the Italsider Taranto Works had the best overall secondary emission control system.

In Japan, both top and bottom blown furnace shops were visited, but all furnaces had closed hood waste gas systems. Of the shops with top blown furnaces, several had secondary emission control systems similar in design and performance to that at Italsider. Again, based on subjective performance estimates, the best secondary emission control system for top blown furnaces in Japan was at the Nippon Steel Yawata Works. The only bottom blown furnace shop visited in Japan (believed to be the only one operating in Japan in 1979) was the Kawasaki Steel Chiba Works. As noted in Table 3-1, this plant incorporates partial building evacuation in addition to furnace enclosures and local hoods to capture furnace secondary emissions.

The Italsider, Nippon Steel, and Kawasaki plants are discussed in detail below to provide a basis for comparison of domestic and foreign technology.

3.3.1 Italsider, Taranto, Italy

The Taranto Works secondary emission control system depends entirely on local hoods for emissions capture. Figure 3-1 shows a flow diagram for the secondary ventilation system. As shown, there are eight collection points, five exhaust fans (one spare) and a dual-section, pressurized baghouse having a total of 10 compartments. Each compartment has 144 bags, which are 300 mm diameter by 9120 mm long, yielding a net total cloth area of 12,400 m^2. The cloth is "Terylene", a synthetic fabric suitable for a service temperature of 130°C. Upon startup of the system, Taranto operated one baghouse with five compartments, later adding the second five compartments. Initially there were three fans, but two more were added. They are now considering the addition of five more compartments as well as additional fans in order to raise the system capacity from 1,000,000 m^3/hr to 1,500,000 m^3/hr. Additional pickup points would then be added such as ladle repair stations.

Table 3-2 shows the design flow and temperature condition at each of the hoods. In considering the table, it should be noted that desulfurizing and deslagging Station 1 is out of service because it provides for pneumatic injection of carbide which is no longer in use. The deskulling station is also out of service because the dust from that operation was too heavy and built up in the ductwork, thereby putting the hood out of commission. A comparison of the total system volume presented in Table 3-2 with the baghouse capacity as shown in Figure 3-1, indicates that time-sharing of the suction capacity among the various operations is practiced. It also indicates that gas cooling takes place in the suction duct between the hoods and the baghouse. In normal operation, four of the existing five fans are operating and one is in standby condition. The bags are cleaned by reverse air flow which was originally provided by a small auxiliary blower.

Figure 3-4 shows a general arrangement of the doghouse (furnace enclosure) and the main suction (charging) hood at the converter. Not shown are two hinged doors of heavy plate at the front of the furnace, each about four meters high. The back end of the doghouse is closed by means of hinged plate doors, however, the front is open except for partial closure by a chain curtain at the top which serves to direct the fumes into the opening of the hood. At the front of the doghouse, there is the main hood with three opening as shown in

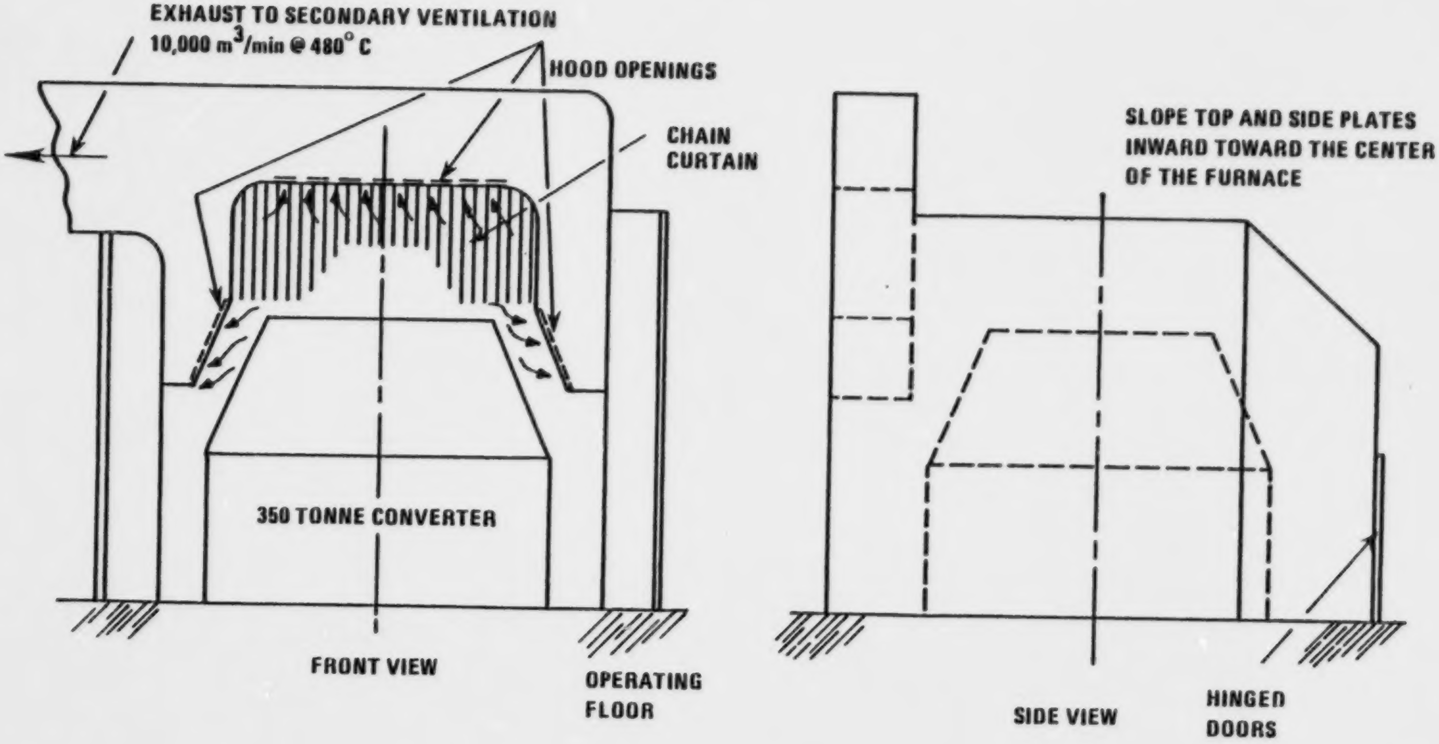

EXHAUST TO SECONDARY VENTILATION
10,000 m^3/min @ 480° C
HOOD OPENINGS
CHAIN CURTAIN
350 TONNE CONVERTER
FRONT VIEW
OPERATING FLOOR
SLOPE TOP AND SIDE PLATES INWARD TOWARD THE CENTER OF THE FURNACE
SIDE VIEW
HINGED DOORS

FIGURE 3-4. Italsider-Taranto basic oxygen steelmaking-doghouse arrangement.

TABLE 3-2. SECONDARY VENTILATION SYSTEM SUCTION VOLUMES

Hood Description	Flow, m^3/min		Temperature, °C
1. Converter hood			
a. Open - Hot metal charging	10,000		480
b. Closed - Puffing during blow	2,500		60
2. Deslagging	3,000		200
3. Desulfurization	1,800		130
4. Hot metal transfer	3,000		130
5. Deskulling	1,500		150
TOTAL FLOW	21,800	Average Temp.	294
	= 1,300,000 m^3/hr		

Figure 3-4. At the rear, there is a smaller auxiliary hood to collect a portion of the emissions from tapping the furnace. The other portion is directed to the front hood by means of the sloping sections in the roof and sides of the doghouse at the rear.

The sketch of Figure 3-4 was made by visual observation during the visit without measurements. It is, therefore, to be taken as a rough approximation of the actual arrangements. The upper hood face (charging hood) was estimated to be 7.6 m wide. The upper face opening appeared to be about 60 cm wider on each side than the outside diameter of the hood skirt.

Figure 3-5 shows a drawing of the hood at the hot metal transfer station. As shown, the top of the furnace ladle fits into close configuration with the bottom of the hood which, therefore, provides a continuation to the exhaust system. The ventilating slot is approximately 1½ to 2 m wide for admission of the molten iron to the furnace ladle and for fume capture from the torpedo car. The hood is arranged so that it extends well beyond the center line of the torpedo car. The entire hot metal transfer station is partially enclosed by a separate building which is external to the BOF shop. The building is open on both ends to permit movement of torpedo cars through it by rail.

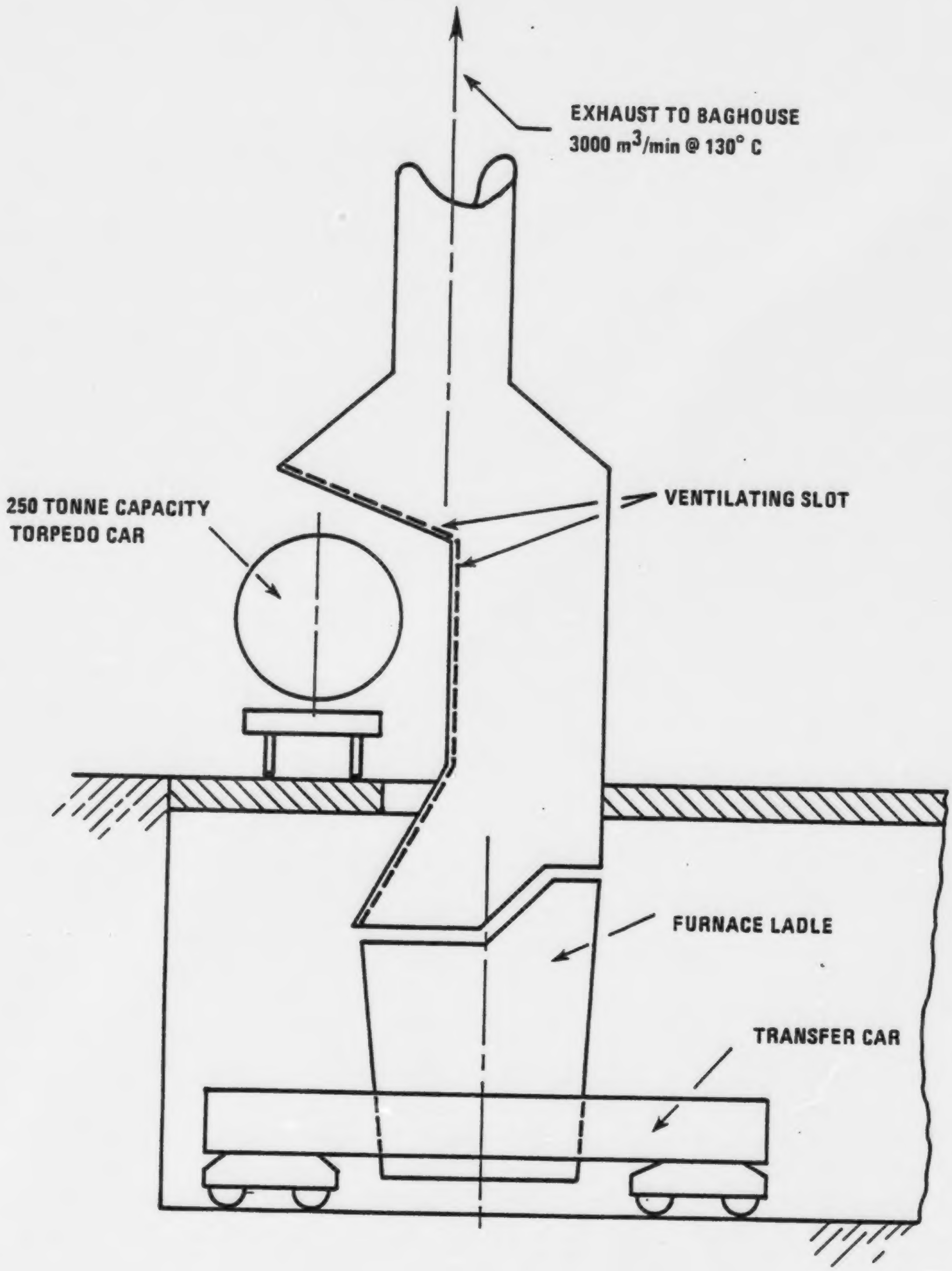

EXHAUST TO BAGHOUSE
3000 m³/min @ 130° C
250 TONNE CAPACITY
TORPEDO CAR
VENTILATING SLOT
FURNACE LADLE
TRANSFER CAR

Figure 3-5. Italsider-Taranto basic oxygen steelmaking - hot metal transfer.

In the desulfurization building, adjacent to the BOF shop, there are two fume collection hoods. One hood serves the deslagging station; the other hood serves the desulfurization station. Both hoods are mounted above the ladle position, closely fitted to it, and of essentially the same diameter as the opening in the ladle. This is made possible by the fact that the ladle is mounted on a transfer car that moves it into place below the hoods. Clearance from the top of the ladle to the underside of the circular hood face in the desulfurization station is approximately 30 cm. The close-fitting deslagging hood or enclosure is actually rectangular (in spite of previous reference to diameter) and is open on the side where the slag rake is mounted. The fourth side of the deslagging hood is effectively provided by the wall of the building.

A highly desirable feature of the secondary ventilation system is the methods which are used for controlling the valves to admit suction at the various hoods. The desirability of the system lies in two factors. One is the provision for a single control valve at each converter which minimizes the number of operating conditions and control variables. The other is the simplified concept of the control scheme as will be described in the following paragraphs.

At each converter hood, there is one valve that is used in two positions, fully opened or closed. When it is opened it will pass 10,000 m^3/min to accommodate the capture requirements during hot metal charge. When the valve is closed, it fits loosely in the duct and permits the passage of 2,500 m^3/min to capture the fumes which result from puffing during the blow, from tapping and slagging the furnace.

Each furnace pulpit has a panel in which there are manually operated controls for the valves as well as indicating lights to show the position, either open or closed, of the valves on each of the three converters. The controls at any vessel are arranged so that the operator can close any of the three valves, but only open the valve pertaining to his vessel. This simple, but effective, concept permits the operator to maximize suction when his vessel is being charged with molten iron and permits him to minimize suction demands from the other two vessels at that time. The concept is made possible by the fact that only one vessel may be charged with molten iron at any single instant.

At the hot metal transfer station, the opening of the valves to the suction hood is interlocked with the control rotating the torpedo vessel in order to pour the iron. Shutoff is controlled by a timer that closes the valve after seven minutes of operation.

At the desulfurizing station, the opening of the valve to the suction hood is initiated automatically upon the descent of the stirring device into the ladle. When the stirring device is withdrawn, the valve is closed. At this location there is also a small exhaust take-off to the carbide handling system.

At the deslagging station, each movement of the rake opens and closes the valve for the suction hood. When the rake travels to its extreme position an electrical interlock opens the valve. When the rake returns to the retract position, the valve closes. This means that during the raking of the slag, the valve opens and closes approximately 15 times a minute. When the rake is in the parked position at the shutdown of the deslagging operation, the valve is automatically closed and remains so.

At Taranto, the special features of particular note were associated with the secondary fume control system. Of particular interest was the simple method of bringing each suction hood on line when needed and insuring that it was closed when not in operation. The other feature of particular note was the side-by-side location of desulfurization and deslagging for the molten iron. This was a very efficient arrangement from the standpoint of operations and, because the ladle was transported by a transfer car which had a tilting feature, it was possible to design a very satisfactory fume capture system. Capture efficiencies were estimated for furnace operations (Table 3-3).

3.3.2 Nippon Steel-Yawata Works

There are two vessels of 300 tonne capacity in the No. 3 BOF steelmaking facility. The capacity of the plant is 300,000 tonnes per month which is equivalent to 1000 heats per month and a 43 minute cycle time, tap-to-tap. Nearly all of the steel, under normal operating conditions, goes to the continuous casting facility which is rated at 260,000 tonnes per month. At the time of the visit, the continuous casting facilities were down for maintenance and the steelmaking vessels were producing only 6 heats per day, equivalent to 18 percent capacity. The hot metal reladling facility consists of a separate

TABLE 3-3. Estimated Hood Capture Efficiencies

Operation	Time-seconds	Estimated Capture -%
Hot Metal Charge		
1	75	95
2	75	92[a]
3	125	93[a]
4	110	88[a]
Oxygen Blowing		
Slopping		95
Puffing		85-99
Turndown		
Sampling		50
Tapping		
1		90-95
2		75-85

[a] Time weighted average

building enclosure which accommodates two torpedo cars on parallel tracks. Between the torpedo cars there is a depressed track in which a transfer car transports a hot metal ladle between the reladling station and the charging aisle of the steelmaking facility. Both torpedo cars are able to discharge into the hot metal ladle.

The arrangement of reladling facilities was shown in Figure 3-3. The building enclosure has a duct at the roof which exhausts the fumes to a remote baghouse. The operating pulpit is at one end and is pressurized and air conditioned. A dual set of fans on the outside of the pulpit window creates a cleared tunnel of vision through the emissions so that the operators may have a clear view of the pouring operation.

There are two large doors into the reladling building. One door is for access of the torpedo car. The other door is for access of the hot metal ladle to the charging aisle. During the reladling operation, both doors are closed.

Before reladling takes place the torpedo car is desulfurized in a desulfurization station which is remote from the steelmaking facility. This station comprises a building which accommodates and desulfurizes two torpedo cars in tandem. This is shown in Figure 3-6. The second floor of the building is used for lance handling equipment and for the storage and handling of the calcium carbide. Injection of the carbide into the molten iron is by the use of nitrogen through a lance which is lowered into the bath. There is a cover on the lance which rests against the opening in the top of the torpedo car, providing a reasonably effective seal.

A separate fume exhaust port in the torpedo car discharges the emissions from the car into an overhead fume hood. In addition, there is a leakage of fumes between the cover and the top opening of the car. Both ends of the passageway for the torpedo cars are open at all times. At each end, there is a lip approximately one meter in height which projects below the underside of the second floor.

The emissions which result from the reladling of the torpedo car and the desulfurization operation are controlled by an auxiliary ventilation system which is separate and apart from the secondary ventilation system of the BOF. Figure 3-7 shows a diagram of the auxiliary ventilation system which has a total capacity of 8100 am^3/min. The fan has a differential pressure of 600 mm of water, requiring a motor of 1500 kW. In addition to the reladling and desulfurization operations, the ventilation system serves the ladle repair area and the track hopper for receiving fluxes.

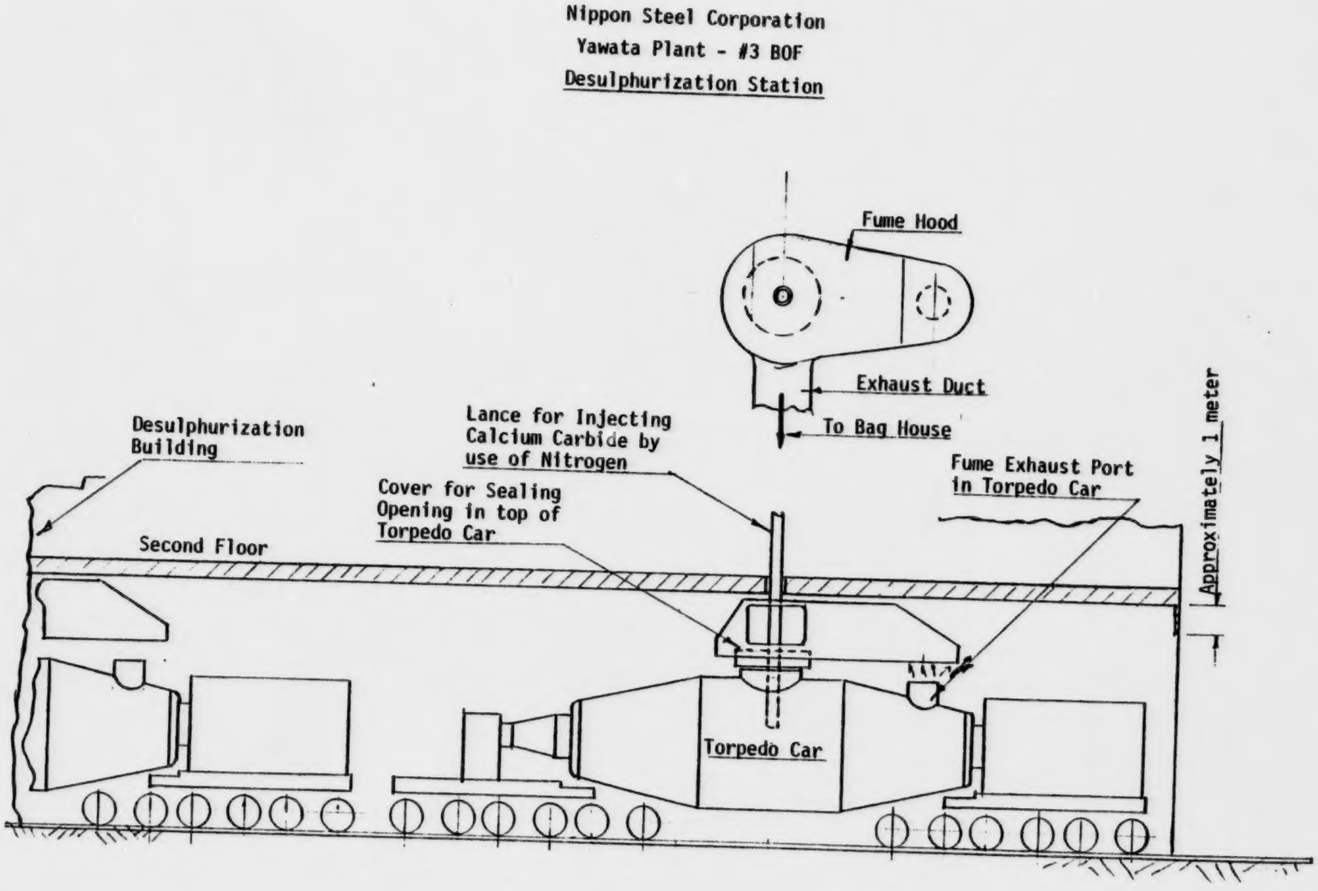
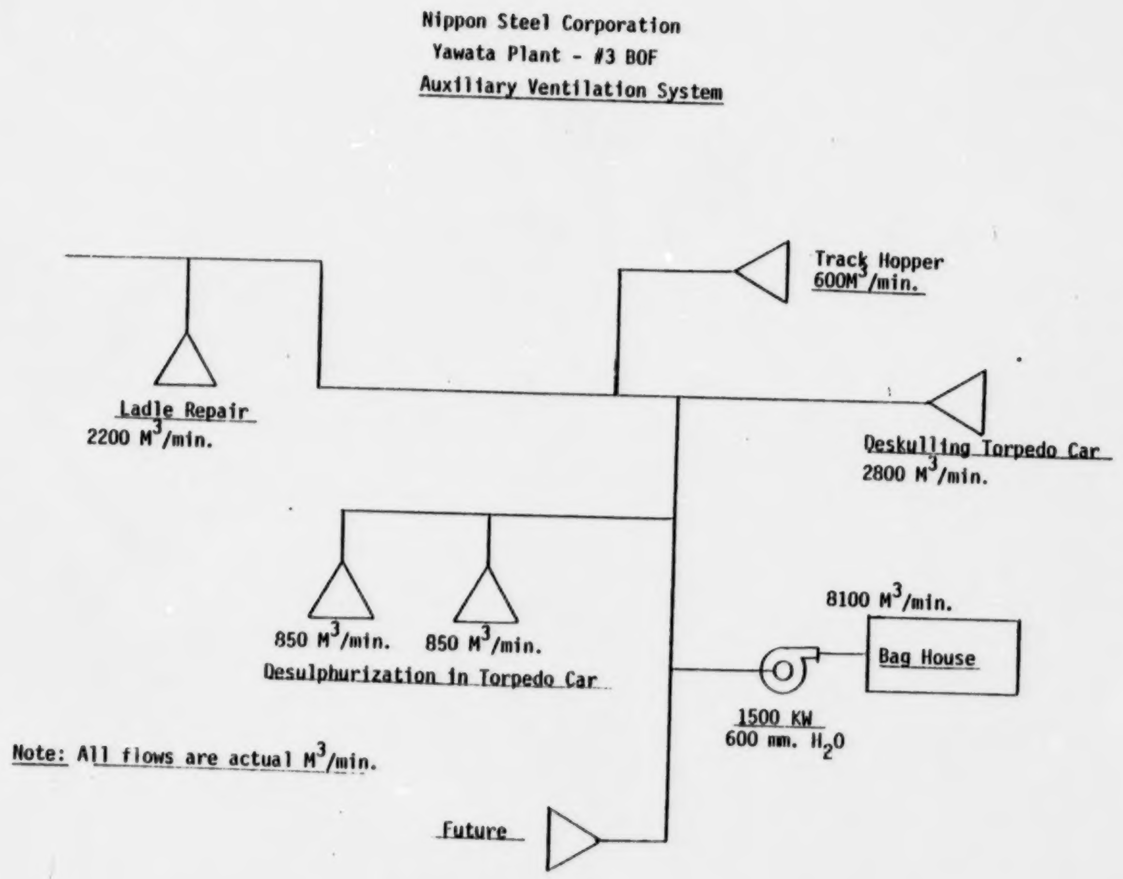

Nippon Steel Corporation
Yawata Plant - #3 BOF
Desulphurization Station
Fume Hood
Exhaust Duct
To Bag House
Lance for Injecting Calcium Carbide by use of Nitrogen
Desulphurization Building
Cover for Sealing Opening in top of Torpedo Car
Fume Exhaust Port in Torpedo Car
Approximately 1 meter
Second Floor
Torpedo Car

FIGURE 3-6. Torpedo car desulfurization facility.


Nippon Steel Corporation
Yawata Plant - #3 BOF
Auxiliary Ventilation System
Track Hopper
600M^3/min.
Ladle Repair
2200 M^3/min.
Deskulling Torpedo Car
2800 M^3/min.
850 M^3/min.
850 M^3/min.
Desulphurization in Torpedo Car
8100 M^3/min.
Bag House
1500 KW
600 mm. H_2O
Future

Note: All flows are actual M^3/min.

FIGURE 3-7. Flow schematic of auxiliary ventilation system.

Figure 3-8 shows the secondary ventilation system which serves the steelmaking furnaces plus a number of auxiliary operations. These operations include deslagging the iron ladle, deskulling the steel ladle, reladling of iron, material handling, etc. The system includes a single baghouse which is rated 21,000 am^3/min. Suction is provided by a fan with a differential pressure of

Figure 3-9 shows the arrangement of the deslagging station for the iron ladle. It comprises a side-draft enclosure with an opening approximately six meters wide by ten meters high for entrance of the hot metal ladle. During deslagging, the ladle is suspended from the overhead charging crane. A front canopy, equipped with a chain curtain serves to increase the efficiency of capture for the fumes.

At the bottom of the enclosure there is a place for the slag pot. During the operation, the slag rake removes the slag from the hot metal ladle. The slag falls into the slag pot. Fumes from the operation which are captured by the enclosure are ducted from the top of the enclosure to the baghouse.

Figure 3-10 shows the arrangement of the enclosure around the BOF steelmaking furnace. Not shown are two sliding doors which are open for entrance of the hot metal ladle and the scrap box and closed during the operation of the furnace and the tapping of the heat. It will be noted that there are only two connections to the fume exhaust, both being at the top of the enclosure near the front.

Efficiency of capture during charging of molten iron and scarp is facilitated by three features in the design. The first are a pair of wing plates, one on each side, which provide a comparatively narrow opening to confine the fumes. The second is the chain curtain which further confines the fumes. Finally, it will be noted that the upper end of the enclosure fron has a sloped plate which projects substantially beyond the mouth of the furnace when the latter is in the tilted position. This latter feature provides a clear vertical path for the fumes from the mouth of the vessel into the top of the enclosure and from there to the suction ducts.

The normal charge of scrap is 13 percent, mostly No. 1 heavy melting, recycled from the steelmaking operations. Approximately 500 to 700 tonne per month (0.1 percent) is purchased from the outside.

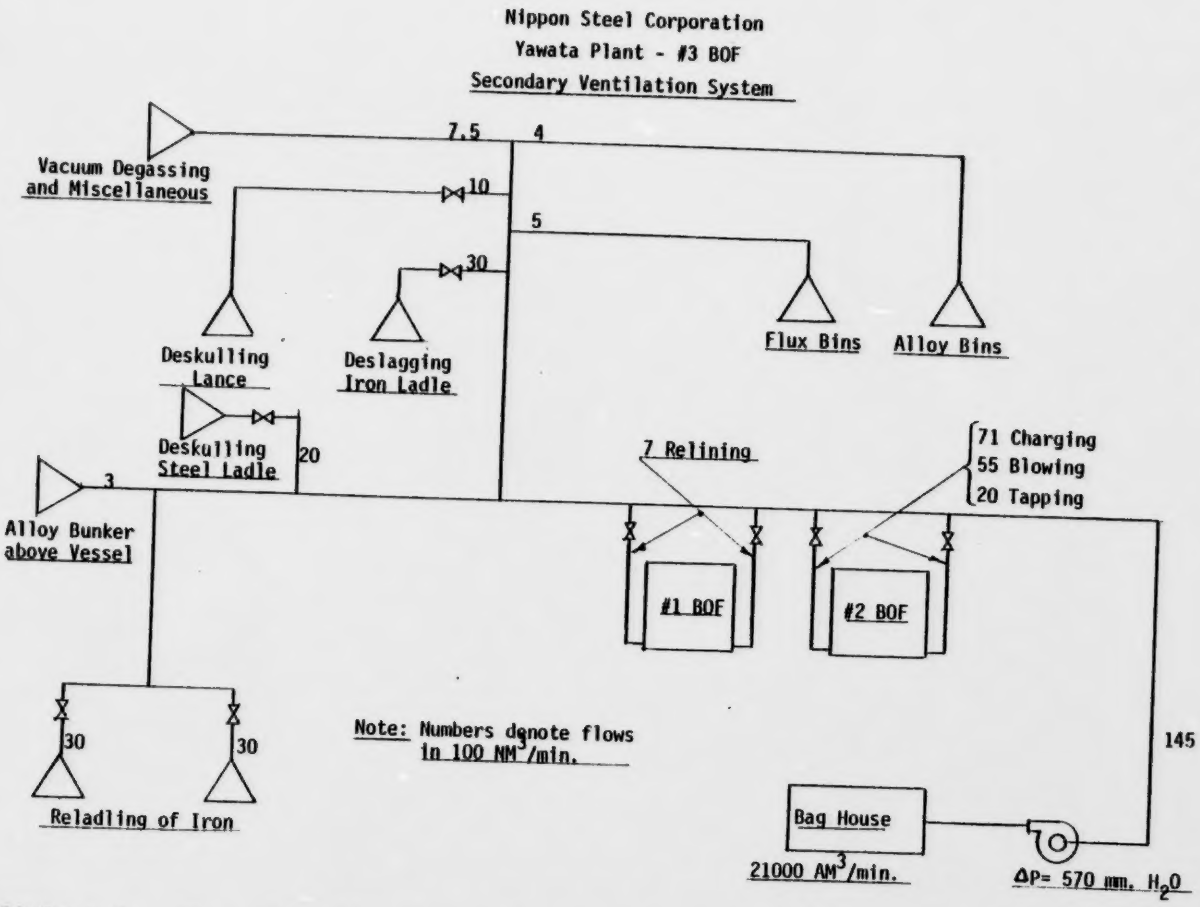

Nippon Steel Corporation
Yawata Plant - #3 BOF
Secondary Ventilation System
Vacuum Degassing and Miscellaneous
7.5
4
10
5
30
Deskulling Lance
Deslagging Iron Ladle
Flux Bins
Alloy Bins
Deskulling Steel Ladle
20
3
Alloy Bunker above Vessel
7 Relining
71 Charging
55 Blowing
20 Tapping
#1 BOF
#2 BOF
30
30
Reladling of Iron
Note: Numbers denote flows in 100 NM³/min.
145
Bag House
21000 AM³/min.
ΔP= 570 mm. H₂O

FIGURE 3-8. Flow schematic of secondary ventilation system.

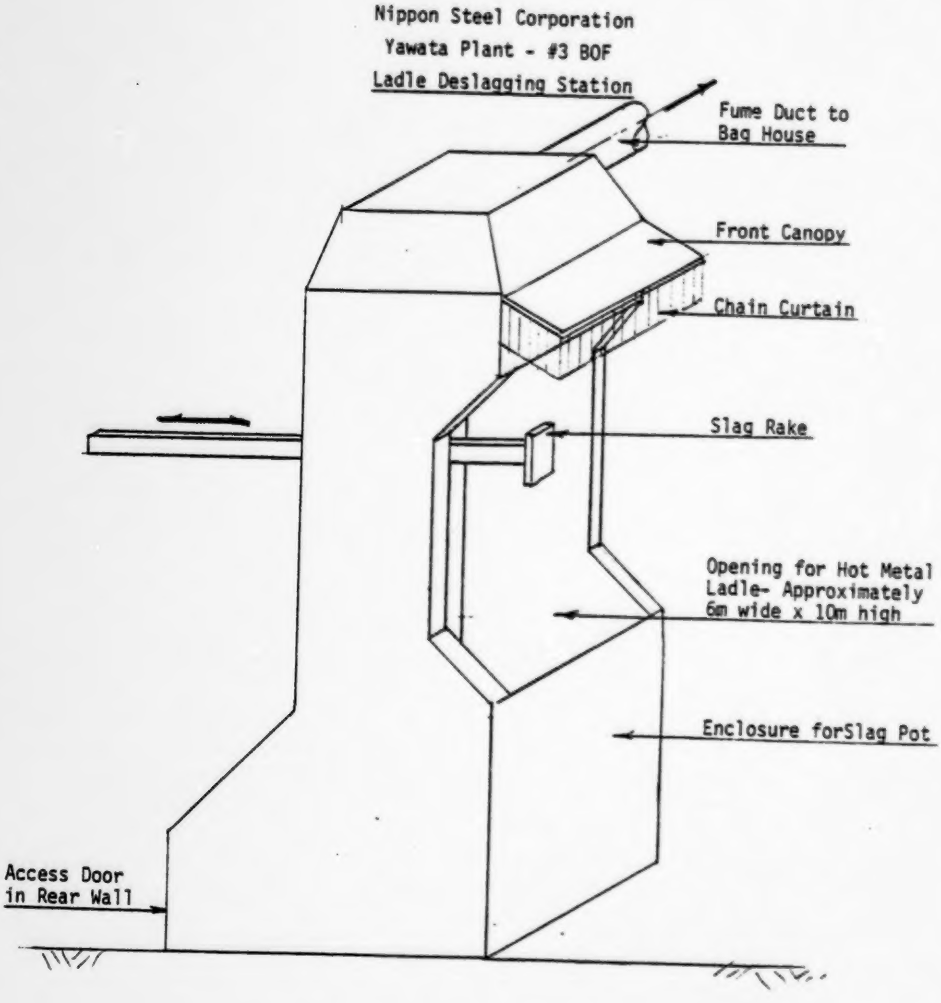

Nippon Steel Corporation
Yawata Plant - #3 BOF
Ladle Deslagging Station
Fume Duct to Bag House
Front Canopy
Chain Curtain
Slag Rake
Opening for Hot Metal Ladle- Approximately 6m wide x 10m high
Enclosure forSlag Pot
Access Door in Rear Wall

FIGURE 3-9. Iron ladle deslagging station.

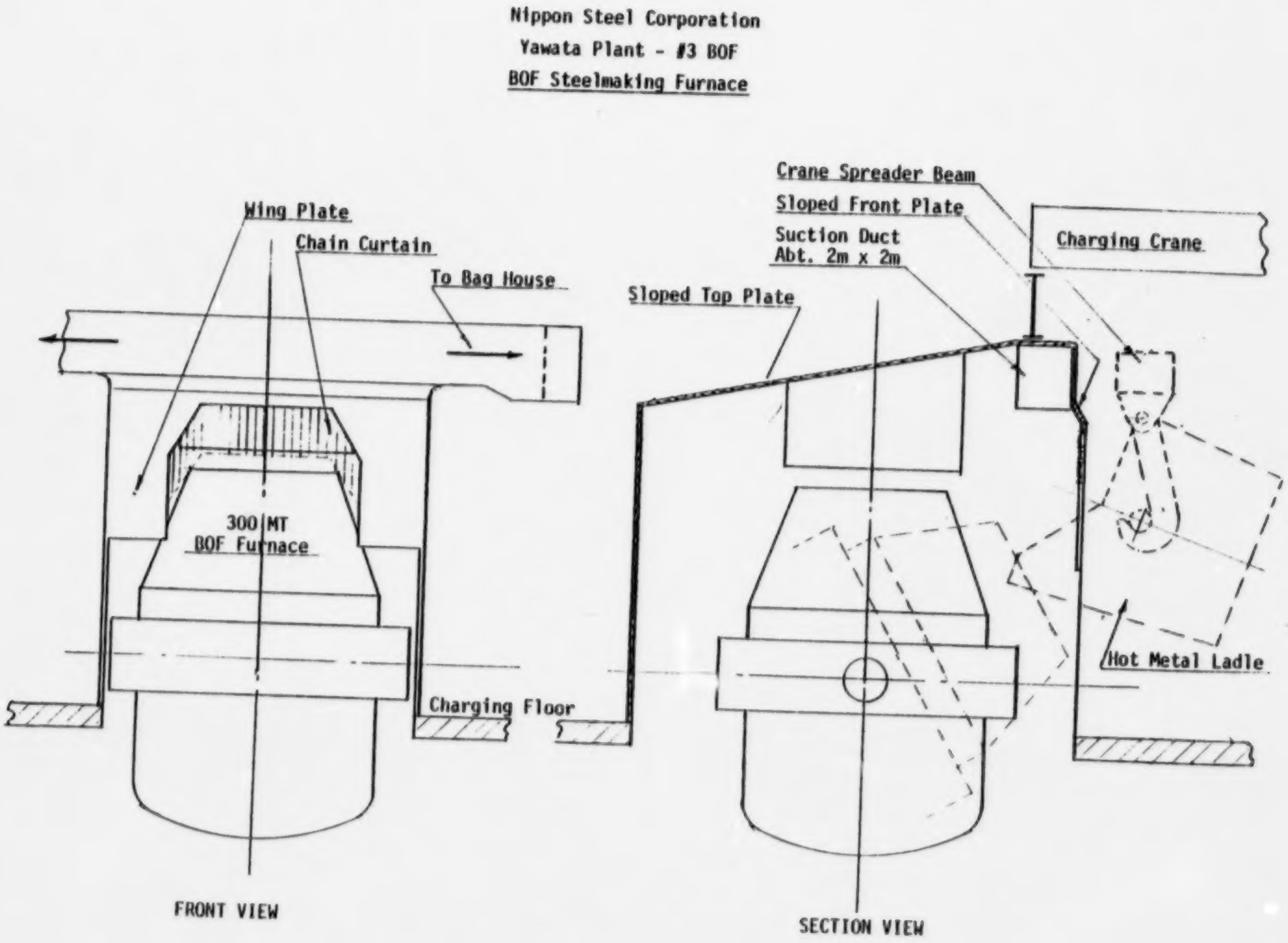

Nippon Steel Corporation
Yawata Plant - #3 BOF
BOF Steelmaking Furnace
Wing Plate
Chain Curtain
To Bag House
300 MT
BOF Furnace
Charging Floor
FRONT VIEW
Crane Spreader Beam
Sloped Front Plate
Suction Duct
Abt. 2m x 2m
Charging Crane
Sloped Top Plate
Hot Metal Ladle
SECTION VIEW

FIGURE 3-10. Furnace enclosure diagram.

As will be noted in Figure 3-8, the suction flow from the steelmaking furnace depends upon the particular operation that is in progress. Table 3-4, below, provides information on typical values.

TABLE 3-4. Converter Emission Control

Operation in Progress	Flow Rate am^3/min
Charging of hot metal or scrap	7100
Blowing the heat	5500
Tapping the steel	2000
Relining the second vessel	700

At the time of the visit, the steelmaking facility was operating at about 18 percent of capacity. No deslagging occurred for inspection. In addition, only one steelmaking cycle was taking place such that the furnace being charged was cold and its refractories were not glowing. This latter condition in particular gives rise to the supposition that emissions were probably lower than normal. Nevertheless, capture efficiencies were excellent as indicated by Table 3-5. Some comments regarding the observations are in order.

During desulfurization, the rate of injection of nitrogen was 450 m^3/hr. for each lance. The amount of carbide injected was 3.5 kg of calcium carbide per tonne of iron. The reaction that took place was violent enough to shake the torpedo car. Approximately 50 percent of the emissions from the car escaped capture by the small hood immediately over the opening. Nevertheless, the small lip in the sidewall below the second floor was sufficient to retain those emissions and prevent their loss to the atmosphere in spite of a strong crosswind which was blowing at the time.

The reladling of iron took place in a separate building which was completely enclosed during that operation. In consequence, there was no possibility of escape of emissions to the atmosphere. Furthermore, the operators were protected from the fume by virtue of the fact that they were in pressurized, air conditioned pulpits.

TABLE 3-5. Capture Efficiencies

Operation	Duration min.	Fumes	Efficiency %
Desulfurizing the torpedo car	10-15	Considerable	100
Reladling the iron		Moderate	100
Deslagging the hot metal ladle		Moderate	Did not see.
Charging molten iron into the BOF	1.5	Considerable	100
Charging scrap into the BOF			None charged.
Blowing the heat		Moderate	100
Tapping the steel from the BOF		Moderate	95 to 100

The emissions during the charging of the vessel with molten iron were completely captured by the furnace enclosure. This may have been due in part to the fact that the vessel was cold before charging and the emissions were lower than would normally be expected. Nevertheless, it is not unreasonable to expect that capture efficiency under more normal operations would be equal to or closely approach the 100 percent that was seen.

During the blowing operation, all of the emissions were contained within the furnace enclosure. There was a slight leak which was observed through the hole in which the lance was inserted, but this was not considered significant. During operations, the vessel was not turned down at any time either for repair or for sampling. The latter was avoided by virtue of automatic sampling equipment which was in place above the furnace enclosure and permitted these functions to proceed during the course of the heat.

Control of tapping emissions was excellent as well except for a very short period at the beginning of the tap. During the tap, there were two openings, one measuring two by two meters, and the other measuring one-tenth by one meter through which the tap was observed. Emissions from these openings were prevented by means of an air curtain that ran off compressed air lines.

Because the facility was at such a low level of operations, no scrap was charged into the BOF vessel and therefore this operation could not be observed. During the blow that was observed, the oxygen flow rate was 1000 m^3/min.

3.3.3 Kawasaki Steel-Chiba Works

This fully integrated steel plant has a total production capacity of 8.5 million tonnes per year. There are three steelmaking plants in operation at the Works. Plants 1 and 2 are top-blown BOF type; their furnace capacities are 85 and 150 tonne, respectively. As a part of a continuing major expansion and environmental control program, begun in 1965, the No. 3 plant with 230 tonne Q-BOP type furnaces (490 m^3 volume) was started up in April 1977. This No. 3 plant was the only one observed during the visit, when total works' raw steel production rates were running about 18,000 tonne/day (70-75% capacity). The furnace charges were running typically 2-5% scrap from the plant.

While only the No. 3 plant was visited, some data was obtained on all three plants:

	Plant 1	Plant 2	Plant 3
-Startup date	6/70	4/62	4/77
-Furnace			
number	2	3	2
capacity, tons	85	150	230
type	BOF	BOF	Q-BOP
-Desulfurization of Iron	yes	yes	yes
-Gas Recovery	yes	no	yes
-Furnace Enclosure, partial	yes	yes	yes
-Furnace Enclosure, full	no	no	yes
-Water Usage, m^3/min	5	3	30

-Secondary Control System (volumes in m^3/min)			
-Desulfurization	1700	1700	
-Deslagging	4500	6700	
-Furnace charging & tapping		11700	18000
-Raw materials handling	1700	3200	
-Building Evacuation*	10000 (bag)	--	27000 (REP)

*collects furnace charging and tapping emissions

Primary Gas Cleaning System

Primary fume is collected in an OG gas recovery system (Figure 3-2), supplied by Kawasaki Heavy Industries. The system has two venturi scrubbers in series. Estimated water usage (make-up) is 30 m^3/min; fume capture, 99 percent. Four 2300 kW fans provide induced drafts; each has a design capacity of 187,000 sm^3/hr at 1,150 mm H_2O.

The dry weight of collected dust varies from 5 to 10 kg per tonne of crude steel (1.2 - 2.3 tonne/heat). The outlet gas dust loading is less than 50 mg/sm^3. Collected dust is granulated along with blast furnace dust using a rotary kiln process (Kawasaki Process) which removes excessive zinc. The granules are returned as feed to the blast furnace.

Secondary Gas Collecting System

Secondary emissions from charging and tapping are controlled by a furnace enclosure, a local hood for partial capture of charged emissions, and partial building evacuation through two roof-mounted wet electrostatic precipitators (REPs) over the charging aisle. Local hoods also control emissions from torpedo-car desulfurization (by calcium carbide injection), from hot metal transfer to ladles, and from ladles during hot metal transfer to ladles, and from ladles during hot metal deslagging (Figure 3-11). All the local hoods at the operations mentioned above, plus those controlling fume and dust emissions from oxygen deskulling of ladles, dumping of kish from hot metal ladles, and flux handling are directed to two fabric filters for dust control. The evacuation rate to the two fabric filters is 1,080,000 m^3/hr.

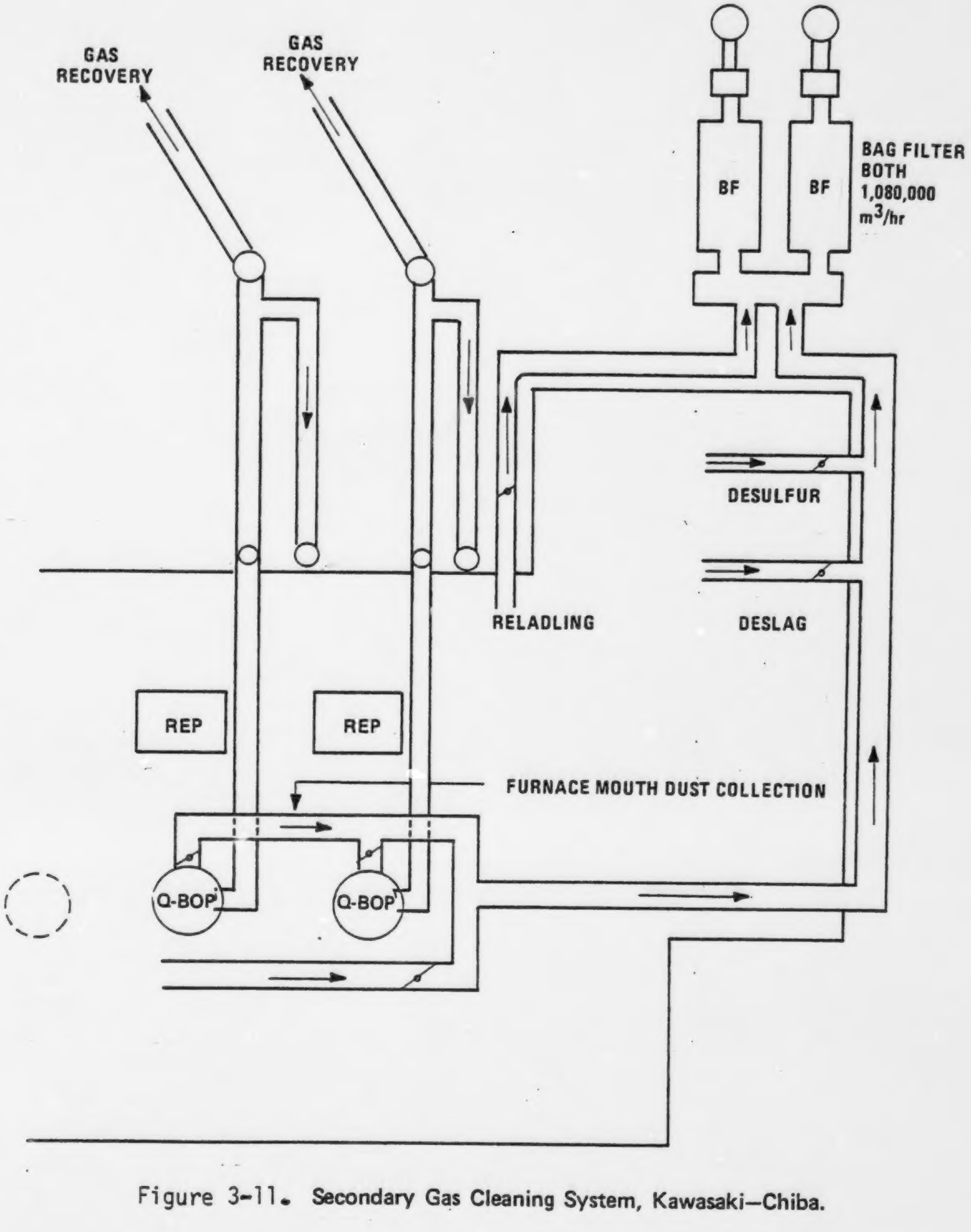

GAS RECOVERY
GAS RECOVERY
BF
BF
BAG FILTER BOTH 1,080,000 m^3/hr
DESULFUR
RELADLING
DESLAG
REP
REP
FURNACE MOUTH DUST COLLECTION
Q-BOP
Q-BOP

Figure 3-11. Secondary Gas Cleaning System, Kawasaki–Chiba.

One REP is located above the charging aisle over each furnace. Air movement through the REPs is generated only by thermal drafts produced by shop heat. The estimated total flow through the REPs is 1,620,000 m^3/hr.

The two fans for the secondary control system draw 1900 kW each, making a maximum power draw of 3800 kW. Average power consumption is reduced to 1700 kW over the entire cycle. This is effected by control of damper positions, damper control sequence, and fan speed throughout the operating cycle. In contrast, the REP handles 70% more air and does so with a total power consumption of 225 kW. This total is divided into 170 kW for the high voltage supply plus 55 kW for dampers, rappers, etc.

Although there are only two furnaces in No. 3 steelmaking plant, the operators have the capability of operating both simultaneously when permitted by their reline schedule. With only one furnace in operation, reladling and deslagging are done in sequence and independent of the furnace operation. With two furnace operation, reladling and deslagging have to be done in sequence. They may occur simultaneously with the blowing of the furnace, but not with the charging operation. The fume exhaust capacity permits the desulfurization operation to take place at any time. In general, hot metal charging requires a 100% flow and the other portions, scrap charging, oxygen blow and tapping are at a lower percentage.

Charging, tapping, reladling, deslagging, and building evacuation were all observed. Desulfurization was only partially observed while passing by the operation.

The Q-BOP vessels are operated within an almost complete enclosure with movable main charging doors, hinged inner doors of heavy plate (about four meters high), and a charging hood. The charging hood exhaust outlet has a local damper for draft control. With both sets of doors open for charging, only the chain curtain of the hood and the ladle effect any closure of the front of the furnace enclosure.

During scrap charge (about 2 percent of total charge) the crane spreader was at the height of the charging hood. Two charges were observed. For the first, moderate fumes were 95-98 percent captured; for the second, moderate fumes were 75-98 percent captured. The charging hood may not have been fully drafted.

When the vessel was turned down to receive the first hot metal charge observed, there was at first no fume. Fuming began however before the hot metal was poured, when gas flow through the vessel tuyeres was started. The first hot metal charge observed took 85 seconds. The ladle was brought very close in a vertical position while the vessel was tilted at a comparatively smaller angle from vertical. From this close position the ladle was lowered until the lip was opposite the vessel mouth. The sides of the furance enclosure almost enclosed the sides of the ladle. As the pour began, considerable fume escaped, building rapidly to a white plume extending outward a distance equal to the diameter of the ladle and rising to the roof. After 60 seconds, fumes ceased for the rest of the pour, but escaped again as the ladle was withdrawn and the doors closed. When the doors were closed and the vessel uprighted, these fumes ceased. Almost at once, when the oxygen flow began, there were puffs of fume and flame that escaped capture until the inner doors were closed. Modest fumes rose from the ladle as it returned to the hot metal transfer station.

For the second observed charge, there was again no fume from the turned down vessel until gas flow began, just before the pour. Scrap evidently had been charged with very low gas flow to the vessel. Again, fumes escaped during the first part of the pour until after 55 seconds at which time the ladle was well into the vessel mouth, and fumes ceased to escape. In this position the ladle acted as a baffle to prevent fumes from rising above the ladle lip, directing them into the charging hood. Some gases began to escape from below the ladle, however. Fumes rose to the REPs at an estimated 3-4 m/s. No visible emissions were evident from the REP during the second scrap and hot metal charge. Kawasaki personnel noted that sometimes visible emissions from the REP are evident near the end of the charge.

An automatic temperature and sampling system is used to avoid turndown of the vessel. Tapping emissions control efficiency was 95-100 percent. There were no large openings at the tap side of the furnace. Emissions were kept within the furnace enclosure by the provision of air curtains at the various observation openings which were placed in the rear of the furnace enclosure. These air curtains were powered by compressed air.

Some slight fumes escaped from small holes in the tapside enclosure doors. These declined as, apparently due to increased draft at the charging hood, smoke from the back side was carried into the charging side, where the doors were kept closed during tapping.

Figure 3-12 shows the plan of the hot metal handling system, including reladling, desulfurization in the torpedo car and deslagging in the hot metal ladle. In the arrangement, the 350 tonne torpedo car enters the facility on one track where it stops for desulfurization and switches to a second track where the molten iron is transferred to the hot metal ladle. As seen in Figure 3-13, a section view, both stations are served by a common exhaust system.

The reladling station and the desulfurization station are in adjacent bays of a partially-enclosed building. The suction hood had baffles on the sides which could be extended downward to enclose more of the torpedo car.

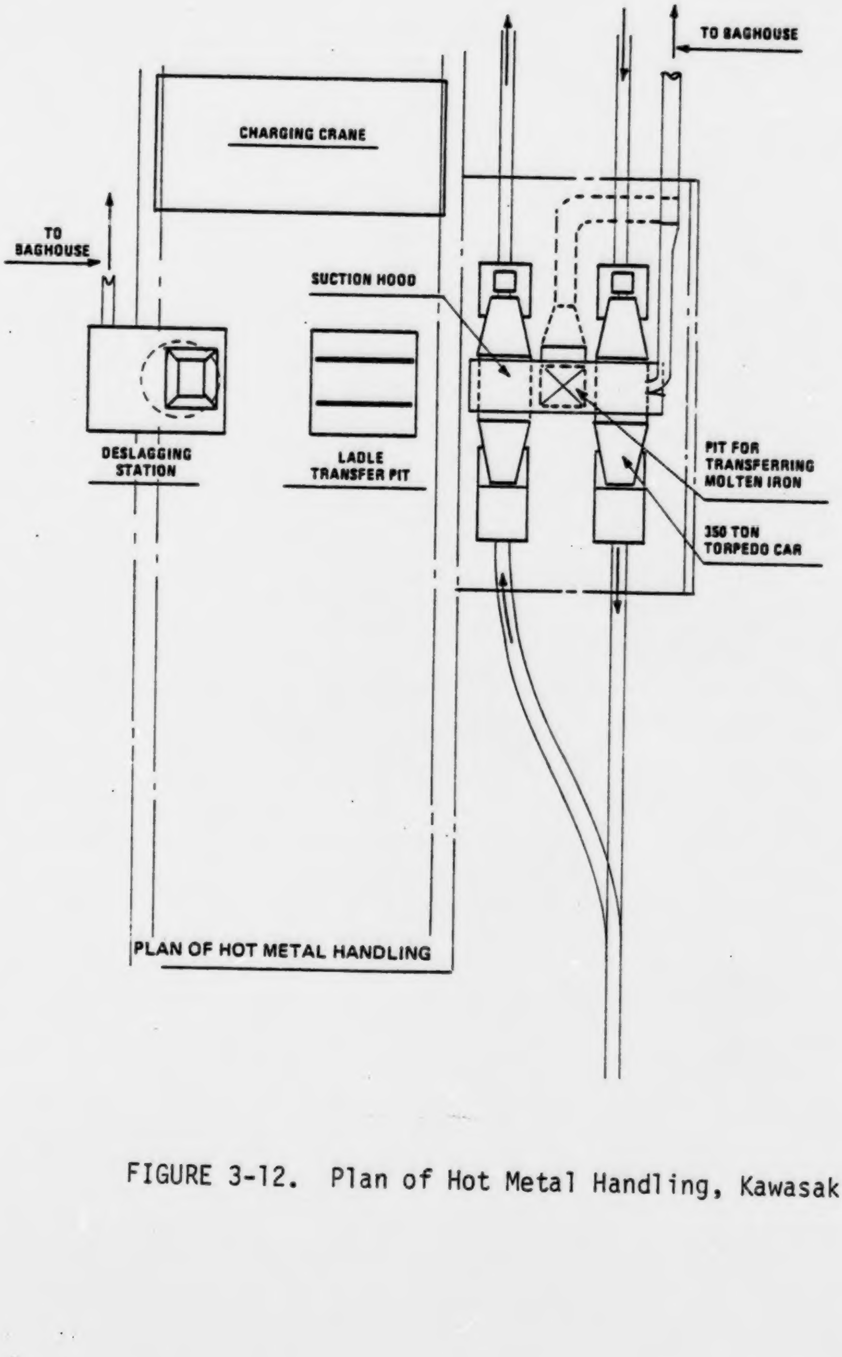
Gas flow seemed to be divided between the two hoods with 80 percent at the lower (ladle) hood and 20 percent at the canopy hood.

Fume capture was estimated to be 95-98 percent. Only a small amount of fume rising out of the ladle was not captured.

Deslagging

Figure 3-14 shows an elevation of the deslagging station which comprises a suction hood, a ladle tilting rig and a compartment to house the slag pot. When the charging crane places the hot metal ladle in the tilting rig, the rig is upright and the hinged section of the hood is swung down to permit placing of the ladle on the tilting rig. The hinged section is then swung up and the tilting rig places the ladle in an angular position ready for deslagging. In this position, the ladle is essentially completely under the hood. Slag that falls from the raking drops through a slag funnel into the slag pot. During this operation, the entry door to the housing is closed and suction is applied to maintain control of fumes. Fume capture was estimated 85-95 percent.

Only a portion of the desulfurization cycle was observed, due to time limitations. The emissions control during that portion was excellent, however, estimated at 95-100 percent.



TO BAGHOUSE
CHARGING CRANE
TO BAGHOUSE
SUCTION HOOD
DESLAGGING STATION
LADLE TRANSFER PIT
PIT FOR TRANSFERRING MOLTEN IRON
350 TON TORPEDO CAR
PLAN OF HOT METAL HANDLING

FIGURE 3-12. Plan of Hot Metal Handling, Kawasaki-Chiba

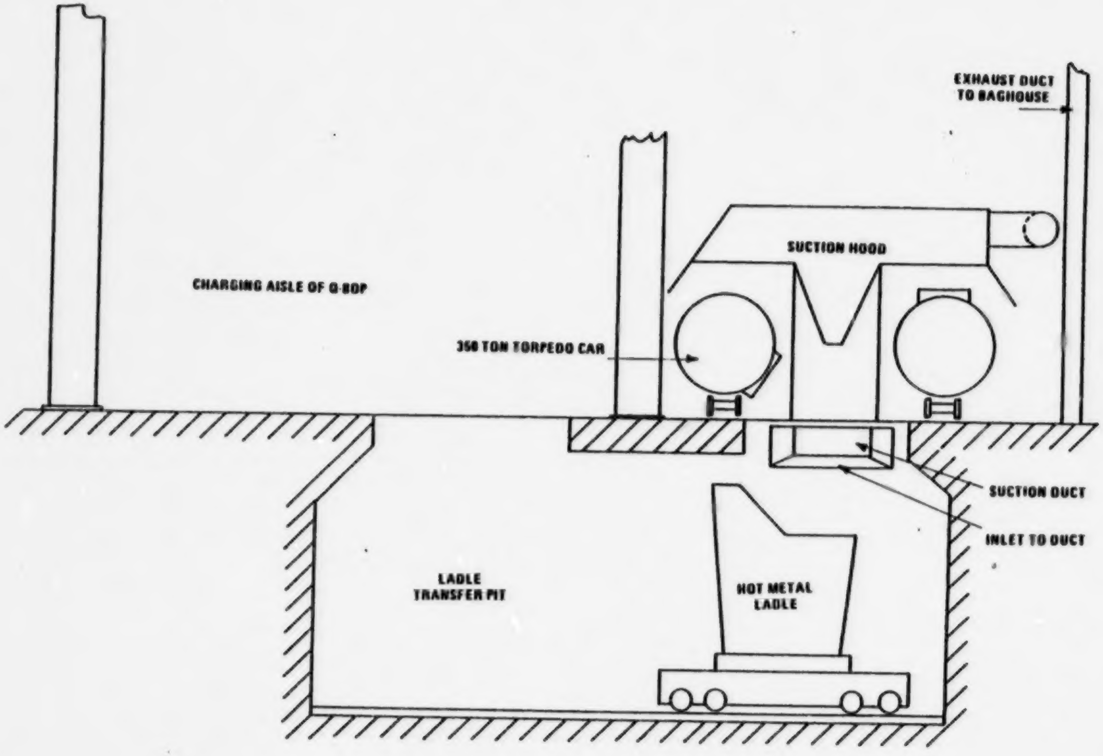

EXHAUST DUCT TO BAGHOUSE
SUCTION HOOD
CHARGING AISLE OF Q-BOP
350 TON TORPEDO CAR
SUCTION DUCT
INLET TO DUCT
LADLE TRANSFER PIT
HOT METAL LADLE

FIGURE 3-13. Section View of Reladling and Desulfurization, Kawasaki - Chiba

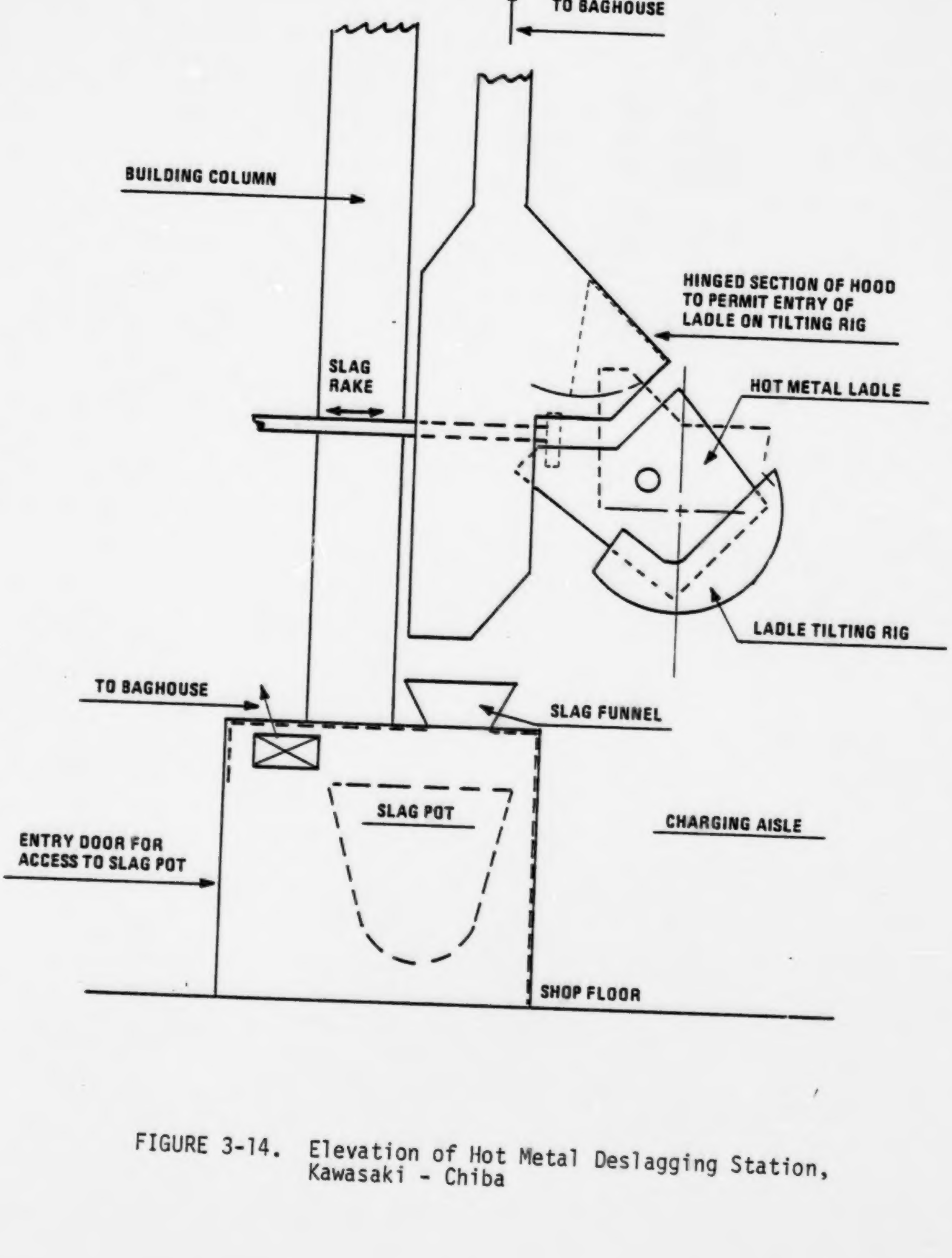

TO BAGHOUSE
BUILDING COLUMN
HINGED SECTION OF HOOD TO PERMIT ENTRY OF LADLE ON TILTING RIG
SLAG RAKE
HOT METAL LADLE
LADLE TILTING RIG
TO BAGHOUSE
SLAG FUNNEL
SLAG POT
CHARGING AISLE
ENTRY DOOR FOR ACCESS TO SLAG POT
SHOP FLOOR

FIGURE 3-14. Elevation of Hot Metal Deslagging Station, Kawasaki - Chiba

Building Evacuation

No visible emissions were observed from the REPs during the second observed scrap and hot metal charge. Observations from outside the building were not made during the first observed charge.

The REPs perform the necessary scavenging function in this shop, capturing fugitive fumes that escape the local hoods, and making possible the attainment of an acceptable level of environmental control. The REP is a versatile and very important technology for adaptation to existing plants as a means of retrofit secondary fume control. For this reason, the design and installation of the REPs were further discussed with the builders (Sumitomo Heavy Industries Inc.) at Kawasaki's recommendation.

As shown in Table 3-6, the observed performances of most secondary emissions controls were very good, with the exception of charging hot metal into the furnaces. Emissions escaping the charging hood were in part captured by the REPs.

TABLE 3-6. Emissions Control Observations Summary

Operation	Fumes	Fugitive Emissions Estimated % Capture[a]
Scrap charge 1	Minor	95-98
Hot metal charge 1	Considerable	60-80
Tapping 1	Moderate	95-100
Scrap charge 2	Minor	75-98
Hot metal charge 2	Considerable	60-80
Hot metal transfer	Moderate	95-98
Deslagging	Minor	85-95
Desulfurization	Considerable	95-100
Blowing the heat	Moderate	95-100

[a] Range of observations by three observers.

3.4 COMPARISON OF FOREIGN AND U.S. TECHNOLOGY

The plant description for Italsider and Nippon Steel Yawata Works in the preceding section provide details of what appeared to be technology superior to that in use domestically in 1978. However, the Kaiser Steel BOF shop at Fontana, California was started up in late 1978. Visible emission evaluation of the Kaiser Steel BOF roof monitor emissions and a review of the secondary emission control system design in early 1980 relative to New Source Performance Standard (NSPS) development[1] revealed the technology at Kaiser Steel to be equivalent to the foreign facilities technology. The local hooding/fabric filter technology at Nippon Steel was applied to more secondary emission sources than at Kaiser, i.e., more widely applied, but not more effectively applied. The relative volume flow rates in the secondary emission control systems per capacity of one furnace are 3,570, 5,240, and 4,980 am^3/hr/tonne at 230°C for Italsider, Nippon Steel, and Kaiser Steel respectively. Figure 3-15 is a flow diagram of the Kaiser Steel secondary emission control system. The Nippon Steel Yawata Works did apply some technology not in use in the U.S. which for top blown furnaces yield minor improvements in furnace emission control. One of those technologies is the use of an automatic metal sampling system that obtains a steel sample while the vessel is in an upright position, thus avoiding turndown emissions. This technology is available under a licensing arrangement with Nippon Steel. The other technology yielding minor improvements is the use of compressed air curtains at furnace enclosure observation ports to prevent fume leakage.

For bottom blown furnaces the use of an automatic sampling system might yield major improvements in capture and control of furnace emissions. Turndown for bottom blown furnaces can produce emissions much more difficult to capture since gas flow must be maintained through the tuyeres. When turndown must be done with oxygen blowing, as is necessary for certain grades of steel, the automatic sampling system impact would be greatest.

The plant description for Kawasaki Steel Chiba Works in the preceding section provides a detailed description of their Q-BOP facility and REPs used for furnace fugitive emission control. In the case of Chiba Works the REPs are used to supplement furnace emission control by furnace enclosures and local hooding.

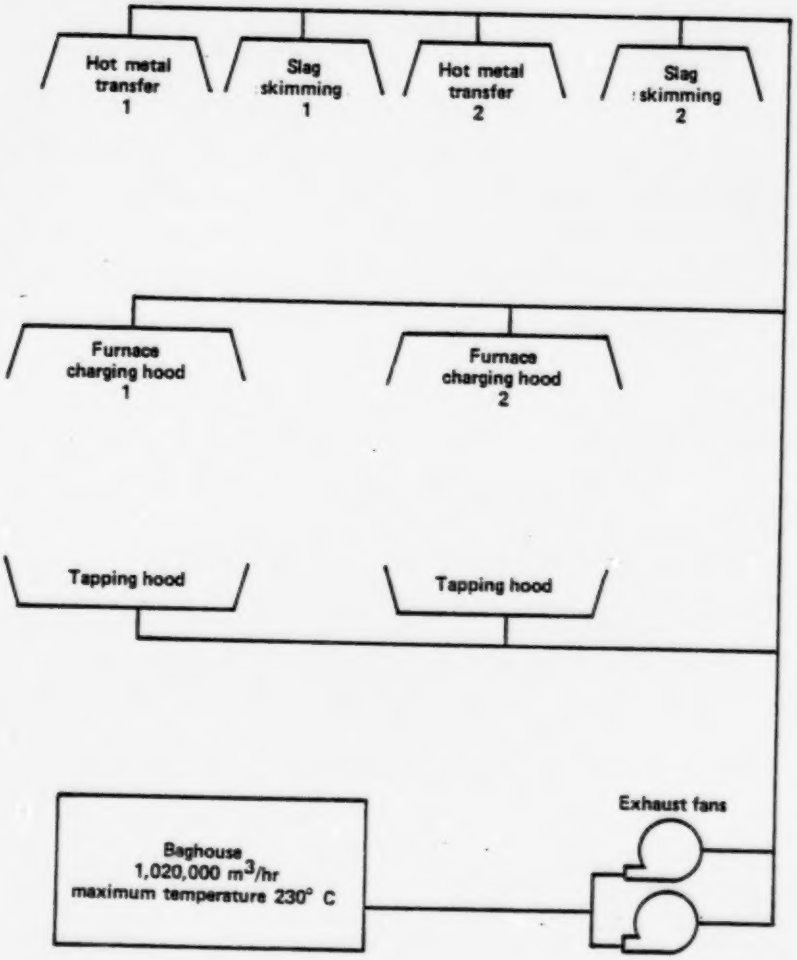

Hot metal transfer 1
Slag skimming 1
Hot metal transfer 2
Slag skimming 2
Furnace charging hood 1
Furnace charging hood 2
Tapping hood
Tapping hood
Exhaust fans
Baghouse 1,020,000 m³/hr maximum temperature 230° C

FIGURE 3-15. Schematic of Kaiser Steel-Fontana basic oxygen secondary emission control system.

At the time of the foreign plant visits, there were three Q-BOP shops operating in the U.S. Two of the plants were using furnace enclosures and local charging hoods to capture furnace fugitive emissions. Figure 3-16 is a flow diagram of the Republic Steel Q-BOP plant at South Chicago. The figure shows that the charging hood for one furnace can be drafted by the fans in both primary emission control systems. In the other Q-BOP plant with furnace enclosure, U.S. Steel at Fairfield, Alabama, draft is diverted from the furnace's own primary control system to the charging hood. One of the three furnaces in the Fairfield plant also has a canopy hood in the charging aisle. The volume flow rates of draft per tonne of one furnace capacity provided to each of the charging hoods are 3,910, 4,250, and 1,400 am^3/hr/tonne at 230°C for Kawasaki, Republic, and U.S. Steel respectively. The single canopy hood at U.S. Steel provides an additional 4,990 am^3/hr/tonne at 230°C. Both the Republic Steel and U.S. Steel plants were subjects of visible emission evaluations as part of the NSPS development effort.[2,3] The data obtained indicated performance of the secondary emission control facilities was much less effective at these plants as compared to Kaiser Steel. The Republic Steel plant was the better of the two Q-BOP plants. Because the observation time at the Kawasaki plant was limited, no definitive statement can be made to compare visible emissions at that plant with the two U.S. Q-BOPs. For the two cycles observed inside the Kawasaki plant, capture appeared to be as good as or better than that achieved at the Republic Steel Q-BOP during tests performed in 1978.[4] Given that the REPs are available to further capture and control fugitive furnace emissions at Kawasaki, the implication is that the overall effectiveness of the secondary emission control at Kawasaki is better than at Republic Steel.

Roof-mounted electrostatic precipitators as described are not in use in the United States. A fugitive emission control scheme based on partial building evacuation, in particular REPs, seems especially appropriate for bottom blown shops where furnace fugitive emissions projected from the furnace mouth are difficult to capture with local hooding. The potential utility of REPs, however, goes beyond bottom blown shop applications. The need to retrofit existing top blown facilities with fugitive emission controls provides other compatible BOF opportunities. REPs are in fact used to capture and control

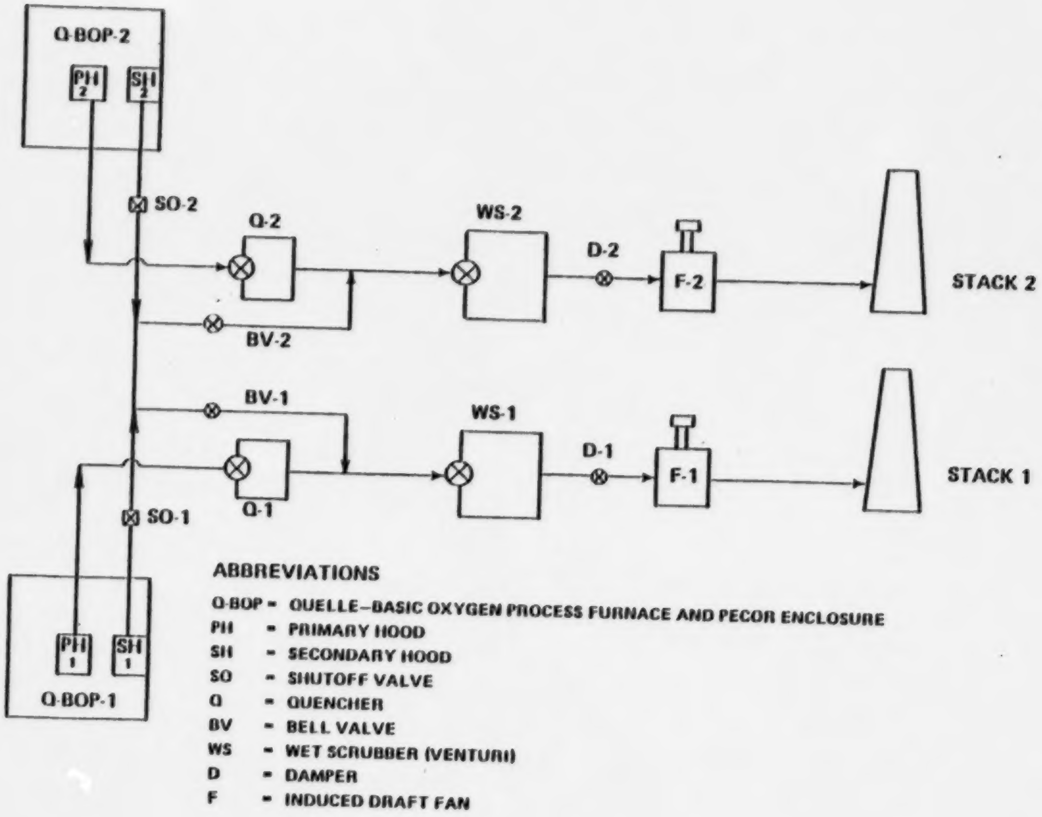

Q-BOP-2
PH 2
SH 2
SO-2
Q-2
WS-2
D-2
F-2
STACK 2
BV-2
BV-1
WS-1
D-1
F-1
STACK 1
Q-1
SO-1
PH 1
SH 1
Q-BOP-1
ABBREVIATIONS
Q-BOP - QUELLE-BASIC OXYGEN PROCESS FURNACE AND PECOR ENCLOSURE
PH - PRIMARY HOOD
SH - SECONDARY HOOD
SO - SHUTOFF VALVE
Q - QUENCHER
BV - BELL VALVE
WS - WET SCRUBBER (VENTURI)
D - DAMPER
F - INDUCED DRAFT FAN

FIGURE 3-16. Republic Steel Corporation's South Chicago, Illinois Q-BOP emission control system.

fugitive emissions in electric arc furnace shops and blast furnace casthouses as well in Japan. For the above reasons, REPs were selected for a feasibility study to show their applicability in a typical U.S. BOF shop.

4.0 FEASIBILITY STUDY FOR APPLICATION OF ROOF-MOUNTED ELECTROSTATIC PRECIPITATORS

The predominant conventional technique for controlling secondary emissions from existing BOF facilities is to provide local hoods at each source. This section examines the alternative of installing roof-mounted electrostatic precipitators (REP). It presents a study which examined the feasibility of such an REP installation for an existing plant. The purposes of the study were to determine the applicability of the devices to the BOF fugitive dust sources, examine the changes needed to existing plant facilities to interface the new equipment with the old, estimate the costs for modification of the existing plant facilities and the addition of new facilities, and examine the expected performance of the proposed REPs.

In performing the study, the following steps were taken:

1. A preliminary quote was obtained for the REP from Sumitomo Heavy Industries, Ltd.
2. Requirements for electrical power supply and spray washing system were investigated.
3. Structural reinforcement to the existing BOF building was investigated.
4. A cost estimate to install and to operate the REP on the roof of an existing BOF building was generated.
5. The quantity of fugitive furnace emissions escaping the building with the REPs in place was estimated.

The results of this study are presented in subsequent sections.

4.1 APPLICABILITY OF REPs TO STEEL FURNACE FUGITIVE EMISSIONS

The applicability of roof-mounted electrostatic precipitators to fugitive steel furnace emissions has been demonstrated, in general, by steel plant operators in Japan. Sumitomo Heavy Industries, Ltd. (SHI) has many operating REP installations, some in the following plants on the indicated process sources:

1. Kawasaki Steel Corporation, Chiba Works, No. 3 Q-BOP, 2 vessels, 230 tonnes.
2. Kawasaki Steel Corporation, Mizushima Works, BOF, 3 vessels, 250 tonnes.
3. Sumitomo Metal Industries, Wakayama Works, BOF, 3 vessels, 160 tonnes.
4. Kobe steel, Kakogawa Works, blast furnace cast house.

REPs are also manufactured by Sumitomo Metal Mining Company (SMM). They have several operating REP installations with one at Kishiwada Steel Company on a 43 tonne electric arc furnace (EAF) shop and another at Tokyo Steel on a 70 tonne EAF shop.

The process furnaces at both Kawasaki Steel plants are closed hood design. At Chiba Works they are OG design and at Mizushima Works the Irsid-Cafl system is in use. The Chiba Works was constructed with a full tapping side and top enclosed with charging side open.

In the case of Mizushima Works, the REPs were retrofit to improve furnace fugitive emission control. The REPs supplement partial furnace fugitive controls (charging and tapping hoods in the furnace enclosures) that apparently were insufficient to meet local pollution control regulations.

The Chiba Work's REPs were constructed as part of the initial plant design. These REPs also supplement local fume capture in the enclosure. Charging hoods alone apparently were believed insufficient for the more difficult fugitive fume capture from bottom blown furnaces. Very limited observations of the REPs at both Kawasaki plants indicated no emissions in excess of 10 percent opacity (individual readings) during a furnace cycle of operation.[5]

At Kishiwada Steel the primary electric arc furnace emissions are captured by a direct shell evacuation system. Control of charging and tapping emissions is achieved entirely by REPs. Some limited visible emissions data (Method 9) taken at this plant are available in US EPA Region III files. Details of the Tokyo Steel installation and a visible emissions evaluation are provided in Section 5.0 of this report.

Two principal differences in the design of REPs supplied by SHI and SMM are the direction of gas flow through the units and the method of electrode cleaning for dust deposit removal. Gas flow through the SHI units is vertical upward. Collection electrode cleaning in the SHI design is by water spray washing. In the SMM design gas flow is horizontal, necessitating two waste gas flow direction changes. These direction changes tend to give the SMM units higher static pressure losses, so the SMM units typically provide a fan to assist for waste gas movement through the collector. Dust removal in the SMM design is by a dry hammer-type rapping system. Depending on geographical location and waste dust recycling or disposal practices, one design may be preferable to the other.

4.2 PRELIMINARY QUOTATION FOR THE REP

Preliminary quotations were requested from both Sumitomo companies, however, only one responded in sufficient detail to satisfy the study needs. Sumitomo Heavy Industries, Ltd. supplied a quotation for an REP installation to serve a BOF facility which meets the following criteria:

Heat size	260 tonne (285 tons) 273 tonne maximum (300 tons)
Hot metal charge	200 tonne (220 tons)
Production	30 to 33 heats per day or 8,500 tonne (9,400 tons) per day
Blow rate, oxygen	570 to 600 acmm (20,000 to 21,000 scfm) normal 650 acmm (23,000 scfm) maximum
Number of furnaces	2

Field measurements at such a facility indicated that the plume from charging and tapping the furnace rose at the rate of approximately 2.7 m/s (9 ft/sec).

At the present time, many BOF facilities operate one furnace at a time. It is possible, however, to increase steel production by relatively minor modifications which would permit two furnace operations. For this reason, it was decided to arrange the REP so that it could accommodate the simultaneous operation of both furnaces. The cost of such accommodation, if provided in the initial design, was nominal and therefore desirable.

Sumitomo Heavy Industries furnished the specification for the REP. It includes two precipitator units that have the capability of handling a total volume 27,000 acmm (953,000 acfm). Included with the units is a set of electrical equipment including high voltage power supplies (45 kV) and water sprays for washing the plates. Spraying takes place automatically for 10 minutes per section after taking sections of the REP out of service.

The specification for the REP is similar to the units which were supplied by Sumitomo to the Chiba Works of the Kawasaki Steel Corporation. Included with the specification was a general arrangement drawing (Figure 4-1) that shows the REP in position on the roof of the assumed BOF facility.

4.3 ELECTRICAL POWER SUPPLY

The continuous electrical consumption for the REP, based on both precipitators operating simultaneously, is as follows:

1.	High voltage supply	170 kW	310 kVA
2.	Insulating fans	14 kW	18 kVA
3.	Area and indoor lighting	5 kW	5 kVA
		189 kW	312 kVA

The power for the REP is proposed to be connected in the existing plant to the spare housing of the existing 4.16 kV, metal-clad switchgear assembly. The existing 4.16 kV switchgear obtains its power through a 5,000 kVA transformer. Since the present load on this transformer has a reactive power factor of 0.95 the present inductive reactance would be essentially balanced by the capacitive reactance of the new load due to the REP, thereby bringing the resultant power factor to approximate unity. Because of these considerations, it was decided that the present 4.16 kV switchgear and transformer would accept the new electrical load from the REP without causing overload conditions.

The control room of the REP is of sheet metal construction with a concrete floor. It is located indoors, in the furnace aisle, at elevation 254 m (835 ft), immediately above the storage bins for furnace additives. The room is provided with ventilation, but without air filtration equipment.

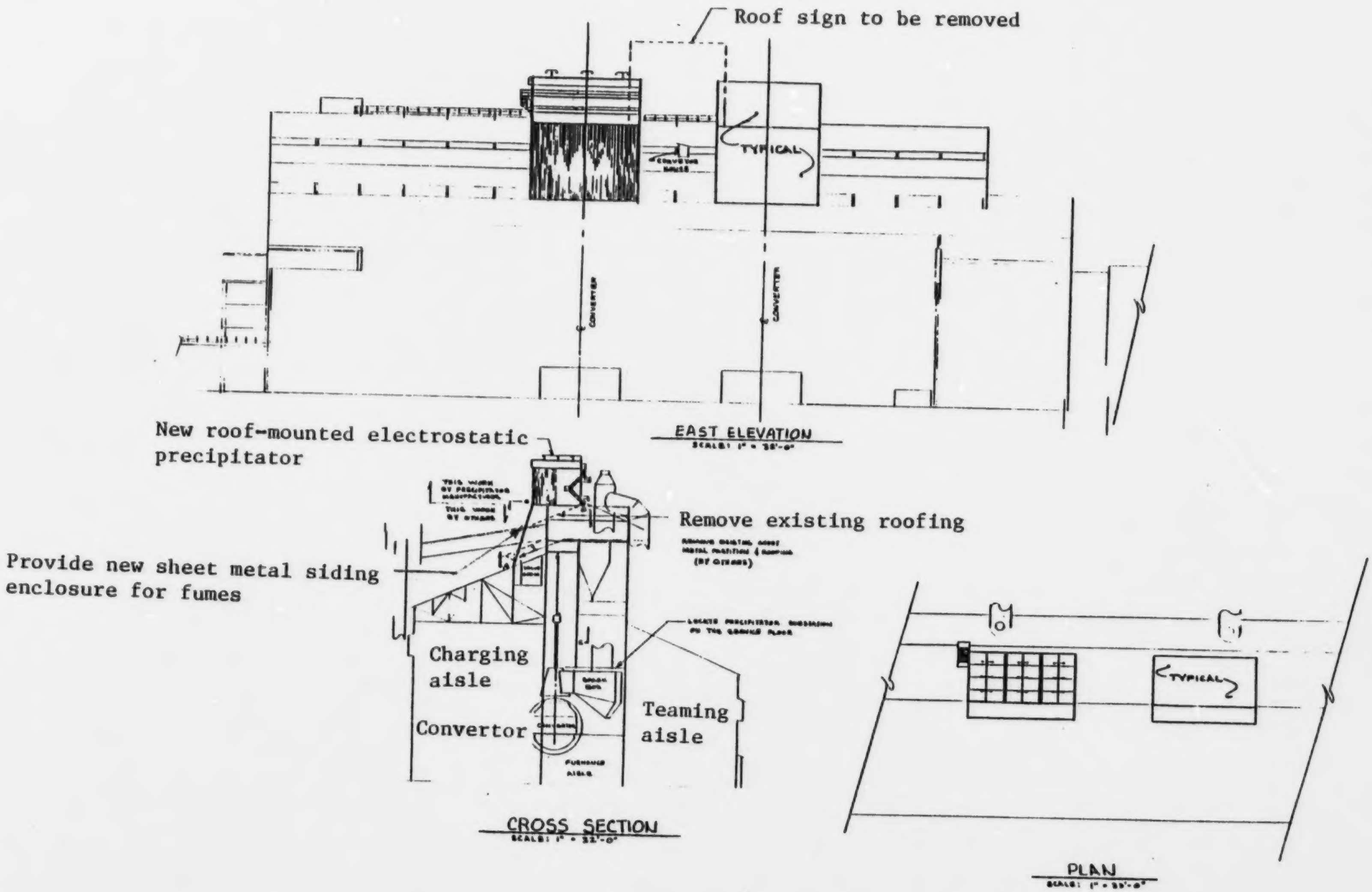

Roof sign to be removed
TYPICAL
CONVERTER
CONVERTER
EAST ELEVATION
New roof-mounted electrostatic precipitator
Remove existing roofing
Provide new sheet metal siding enclosure for fumes
Charging aisle
Convortor
Teaming aisle
CROSS SECTION
TYPICAL
PLAN

Figure 4-1. Proposed installation of roof mounted precipitator on BOF shop.

The new electrical equipment in the control room includes a 4.16 kV/480V, 500 kVA silicon transformer, low voltage switchgear and precipitator controls. The precipitator controls are furnished with the REP and include control units for operating the water valves for the automatic spray washing of the collector plates in the precipitator.

The only other electrical load imposed by the REP installation comes from the new pumps for the spray washing system. There are two pumps, one operating and one stand-by, each being driven by a 37KW (50 HP) 440V, 3 phase motor. The pumps are located on the existing scrubber platform. Power for the pumps is supplied from the existing electrical units in the control room which is also on the scrubber platform.

The existing 4.16 kV substation is located on the ground floor, immediately adjacent to the BOF building. The electrical connection between this substation and the new control room for the REP is provided by means of 4 cables, 5 kV, EPR insulated, installed in a 12.7 cm (5 in) diameter galvanized conduit.

In the new control room, cable duct is proposed for connecting the switchgear to the control units which are supplied with the REP. There is electrical and key interlocking between the new 1,200 A circuit breaker in the existing cubicle No. 7 and the new 600 A load-break disconnect switch at the primary of the new 500 kVA transformer. The control for the new pumps has push buttons in the control center and at the motors with lock-out switches at the motors.

The lighting for the new control room and for the operating areas of the precipitators will be supplied directly from the power bus of the low voltage switchgear. The voltage of the lighting will be 277 VAC. Lighting contactors are provided in the switchgear and low voltage push buttons in appropriate locations. Indoor lighting will be low-bay mercury vapor and outdoor lighting will be sodium vapor units.

4.4 SPRAY WASHING SYSTEM

The continuous water usage in the spray washing system for the REP, based on both precipitators operating simultaneously is as follows:

1.	For sprays	1.2 m^3/min	(317 gpm)	continuous
2.	For sprinklers	0.3 m^3/min	(79 gpm)	180 min/day
	TOTAL	1.5 m^3/min	(396 gpm)	

The supply water to the precipitators is required to meet the following criteria:

Suspended solids	50 ppm, max.
Particle size	840 μm, max.
pH	7-8
SO_4	100 ppm, max.
Cl	100 ppm, max.
Pressure at elevation 258 m (847 ft)	392 kPa (131 ft)

The water spray washing and sprinklers is provided from an existing piping header (Figure 4-2) in the present scrubber water system. Since the BOF has a scrubber on its primary gas cleaning system, the water quality from the clarifier is assumed to be generally adequate for the new service.

In the existing system, the flow rate of the water is 18.2 m^3/min (4,800 gpm). This is the design flow rate when both primary gas cleaning systems are in operation, corresponding to the simultaneous operation of both furnaces. The additional flow for the new REP system is 1.5 m^3/min (396 gpm) which is an increase of 8.3 percent over the design range for the two-furnace operation.

Thus for two-furnace operation, there is a moderate increase in flow which should be easily accommodated in the existing water system.

The spray water in the new REP is used for washing dust from the collecting plates of the precipitators. After receiving the dust from the washing operation, the water flows to the existing callow cone of the present scrubber system. The following calculations indicate the effect on the present system which results from the new contaminated water:

1. Amount of dust collected in the REP. 0.35 kg/tonne (0.7 lb/ton) of dust from charging and tapping x 8,500 tonne/day (9,400 tpd) of steel produced = 2,970 kg (6,580 lbs) per day. (This calculation is based on the emission factor from Reference 3.)

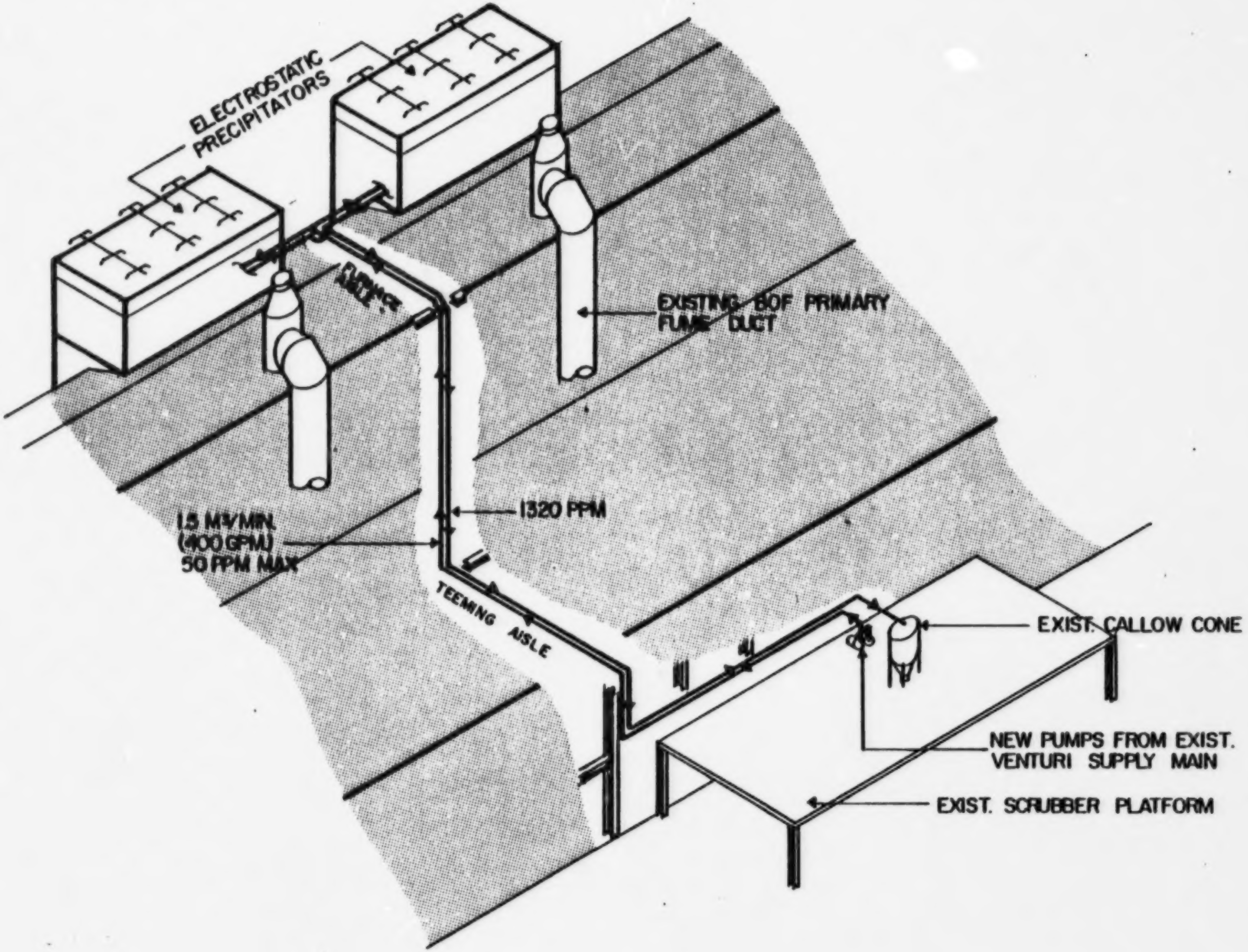

ELECTROSTATIC PRECIPITATORS
FURNACE AISLE
EXISTING BOF PRIMARY FUME DUCT
1320 PPM
1.5 M³/MIN. (400 GPM) 50 PPM MAX
TEEMING AISLE
EXIST. CALLOW CONE
NEW PUMPS FROM EXIST. VENTURI SUPPLY MAIN
EXIST. SCRUBBER PLATFORM

FIGURE 4-2. Water supply and return flow diagram.

At a guaranteed collection efficiency of 91.5 percent, the amount of dust transferred to the water is:

$$.915 \times 2{,}970 \text{ kg/day} = 2{,}720 \text{ kg/day } (6{,}020 \text{ lbs/day})$$

2. Quality of spray water after washing (one furnace operating)

$$\frac{2{,}720 \text{ kg/day}}{1{,}440 \text{ min/day}} \times \frac{1}{1.5 \text{ m}^3\text{/min} \times 1{,}000 \text{ kg/m}^3} \times 10^6 + 50 \text{ ppm}$$

$$= 1{,}310 \text{ ppm of particulates}$$

3. Flow increase to existing water system. The design flow to the callow cone for two-furnace operation is 10.0 m^3/min (2,650 gpm). For one-furnace operation, the flow is reduced to 5.6 m^3/min (1,470 gpm). Considering the new added flow of 1.5 m^3/min (396 gpm) from the REP, under two-furnace operation, the flow will be 15 percent above design and there will be an addition of 300 ppm to the suspended solids in the inlet water. Under one-furnace operation, the flow will be 30 percent less than design and there will be an addition of 270 ppm to the suspended solids.

   Under one-furnace operation, the scrubber water system is able to accept the new added flow from the REP without exceeding the design parameters of the system. Under two-furnace operation, if such takes place in the future, the system may require modification, primarily to the callow cone, unless there is sufficient excess capacity in that unit to accept the small overload which would then occur.

   The addition of water from the REP to the existing scrubber water system imposes a moderate increase in water flow and in the quantity of suspended solids. Under one-furnace operation, there is enough reserve capacity in the existing system to accept the additional loads. If two-furnace operating takes place in the future, minor additions to the existing scrubber water system may be required at that time.

The water supply and return system for the REP is shown in Figure 4-2. It has two pumps, one operating and one stand-by, each rated 1.1 m^3/min (300 gpm) at 100 m (300 feet) tdh. Because of the relatively low flow and high head, it is necessary to operate the pumps at approximately 2,600 rpm and to drive them through V-belting. The pumps are located in the clean water supply system, the return of contaminated water being by gravity flow. In order to insure long life under continuous service and high rotating speed, it is recommended that the pumps be heavy-duty, Refrax lined.

The water supply system includes motor-operated valves to isolate the flow to each precipitator. These valves are controlled from a remote location in the BOF building, thereby facilitating individual operation of the REPs if desired.

4.5 STRUCTURAL REINFORCEMENT OF BOF BUILDING

The most critical consideration in the proposal to install two roof-mounted precipitators on the existing BOF building is the ability of the building to safely carry the new loads.

Figures 4-3 and 4-4 show some of the structural modifications and additions which are required to sustain the new loads. Several conditions of particular importance are as follows:

1. The load of the precipitators is carried by new steelwork into the columns on either side of the furnace aisle, per Figure 4-3. Although each precipitator spans 3 columns in the north-south direction, the stringers under the precipitators are arranged to carry the loads into the end columns only. The center columns do not run to the ground but span the furnaces. It was decided, therefore, not to impose any additional loads on these center columns.

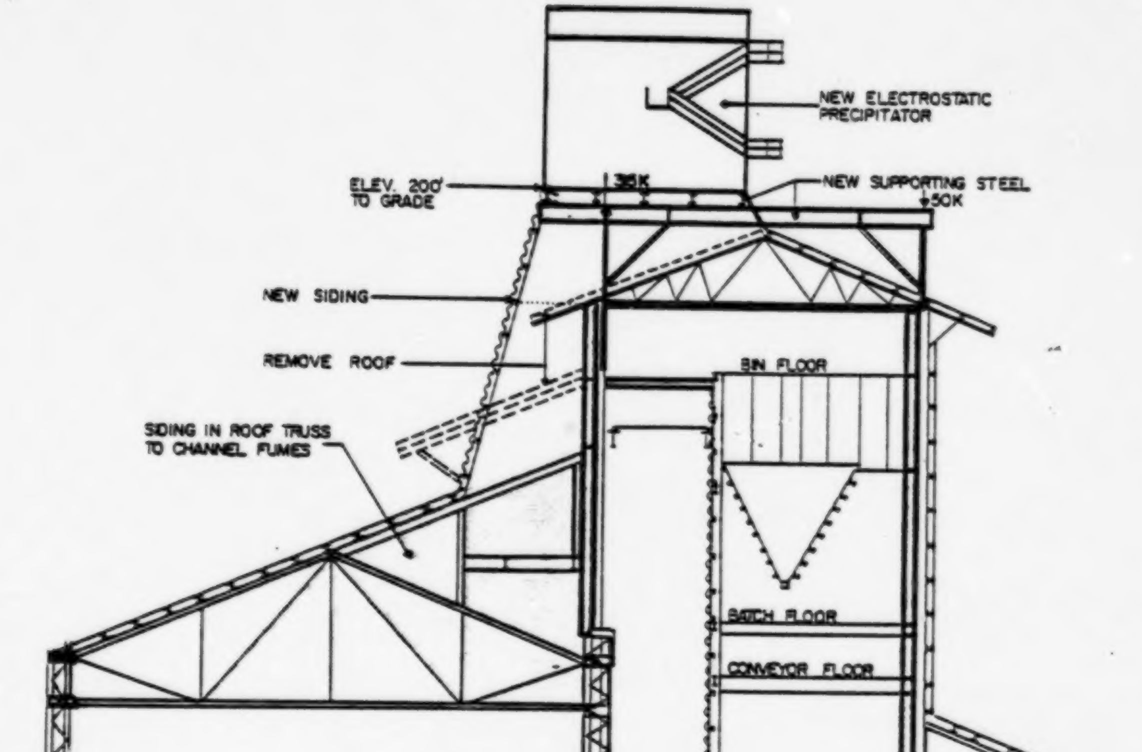

NEW ELECTROSTATIC PRECIPITATOR
ELEV. 200' TO GRADE
35K
NEW SUPPORTING STEEL
50K
NEW SIDING
REMOVE ROOF
BIN FLOOR
SIDING IN ROOF TRUSS TO CHANNEL FUMES
BATCH FLOOR
CONVEYOR FLOOR
CHARGING CRANE
SERVICE FLOOR
REINFORCE CONNECTIONS
TEEMING CRANE
OPERATING FLOOR
CHARGING AISLE
FURNACE AISLE
TEEMING AISLE

FIGURE 4-3. Structural reinforcement of existing BOF building.

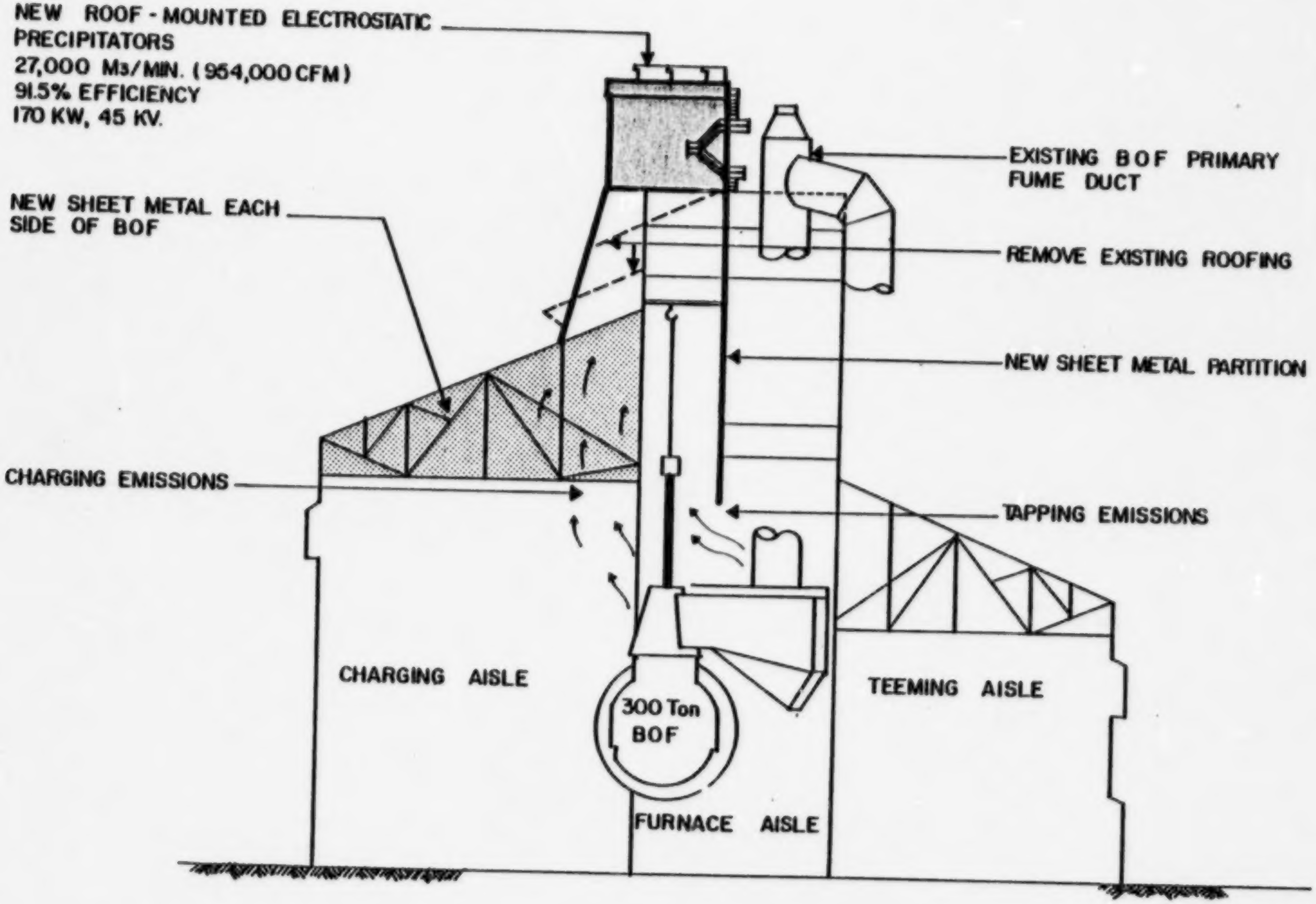

NEW ROOF-MOUNTED ELECTROSTATIC PRECIPITATORS
27,000 M3/MIN. (954,000 CFM)
91.5% EFFICIENCY
170 KW, 45 KV.
NEW SHEET METAL EACH SIDE OF BOF
CHARGING EMISSIONS
EXISTING BOF PRIMARY FUME DUCT
REMOVE EXISTING ROOFING
NEW SHEET METAL PARTITION
TAPPING EMISSIONS
CHARGING AISLE
300 Ton BOF
FURNACE AISLE
TEEMING AISLE

FIGURE 4-4. Cross section of BOF.

2. The dead load of each precipitator is 138.6 tonnes, thereby adding a new load to the building of 277.2 tonnes. This load may be accommodated by the existing steelwork without serious problems.

3. The most serious structural considerations are the horizontal loads which result from a design wind loading of 161 km/hr (100 mph). The horizontal loads in the north-south direction require the provision of new X bracing between column lines Nos. 10 and 12. The bracing chosen for the estimate is somewhat overdesigned and further detail analysis may result in reduction of the sections. The new structure immediately under the precipitators has horizontal and vertical wind bracing in each direction.

4. The horizontal wind loads in the east-west direction are of greatest concern, particularly in the existing steelwork above elevation 228 m (749 ft). Below that elevation the columns are of heavy section and there is substantial wind bracing. Above that elevation, the columns are drastically reduced in size and there is relatively little wind bracing.

It should be noted that the BOF building is unsymmetrical in cross-section. Because of this condition, because the wind-loads on the new precipitators are high, and because the supporting columns have unusual configuration and size, computer "stress" runs were made using four loading cases and assuming fixed and pinned bottom connections:

1. Existing structure -- wind to the east
2. Existing structure -- wind to the west
3. Structure with precipitators -- wind to the east
4. Structure with precipitators -- wind to the west

The analysis showed that the structure below elevation 228 m (749 ft) was adequate; however, there appeared to be excessive lateral drift at the roof line of the furnace aisle.

Because of the computer analysis, there is serious concern about the ability of the structure to accommodate the new wind loads in the east-west direction. This concern is somewhat tempered by the fact that the BOF building has extensive horizontal bracing which unifies the structure and transfers load from one column to the next. The computer analysis did not allow for this distribution of wind load on the precipitator.

For the purpose of the preliminary design and cost estimate, it was decided to reinforce the columns under the precipitators down to elevation 228 m (749 ft). Also K-bracing is proposed above elevation 255 m (835 ft) in order to increase lateral stiffness. It is anticipated that these measures will provide adequate reinforcement for the existing building. Nevertheless, further investigation and analysis will be required to definitely prove this contention. In making the analysis it will be necessary to re-examine certain critical structural connections to insure that they are adequate to meet the new loadings.

Figures 4-3 and 4-4 show modifications to the sheet metal siding. The purpose of the modifications is to direct the secondary emissions from the furnace into the bottom of the new precipitators. The modifications include removal of roofing in the way of the precipitators and the provision of new siding in three general areas. These are:

1. From the roof of the charging aisle to the east side of the precipitator.
2. In the furnace aisle on the west side of the lance crane.
3. In the roof trusses of the charging aisle at column lines Nos. 7, and 15.

4.6 ESTIMATE OF COSTS

The estimates of costs for installing and operating the REP are given in Tables 4-1 through 4-5. In all cases, the costs are based on the third quarter of 1982. Costs for this period were obtained by first preparing estimates for the third quarter of 1980 and then applying escalation factors. The factors are assumed to be 15 percent per year resulting in a two-year value of 32 percent.

TABLE 4-1. Electrical Installation Costs for Roof-Mounted Electrostatic Precipitator

1.	Air circuit breaker, including controls	$ 22,000
2.	Equipment in electrical equipment room	67,000
3.	Electrical cable	10,500
4.	Conduit and fittings	16,000
5.	Starters and controls	3,500
6.	Lighting	9,000
7.	Labor to install switchgear, items 1 and 2	67,000
8.	Labor to install conduit, cable and controls	90,000
9.	Engineering	5,000
10.	Contingency, 10 percent	30,000
	TOTAL	$320,000

TABLE 4-2. Process Piping for Roof-Mounted Electrostatic Precipitator

1.	2 Refrax-Lined pumps, 200 GPM @ 300 Ft. TDH	$31,700
2.	6" Main piping	15,000
3.	4" Branch piping	9,800
4.	Foundation & Installation of Pumps	5,000
5.	Crane Service	8,500
6.	Spares 2 percent	1,400
7.	Engineering 10 percent	7,000
8.	Contingency 15 percent	11,600
	TOTAL	$90,000

TABLE 4-3. Structural Reinforcement Costs for Roof-Mounted Electrostatic Precipitator

1.	Precipitator support framing, 70 tons	$ 185,000
2.	Column reinforcing, 150 tons	495,000
3.	Connection reinforcing	150,000
4.	Wind bracing in BOF building, 40 tons	90,000
5.	Miscellaneous framing, 20 tons	46,000
6.	Purlins, 35 tons	70,000
7.	Siding, 50,000 sq. ft.	116,000
8.	Electrical control room	33,000
9.	Remove sign	35,000
10.	Remove roofing	20,000
11.	Crane rental	100,000
12.	Contingency, 15 percent	200,000
13.	Engineering	80,000
	TOTAL	$1,620,000

TABLE 4-4. Installation of REP--Summary of Capital Costs

1.	Roof mounted electrostatic precipitator materials, fabrication and engineering[2] [3]	$2,090,000
2.	Shipping from Japan	40,000
3.	Field erection of REP	890,000
4.	Electric power supply	320,000
5.	Process piping	90,000
6.	Structural reinforcement of BOF building and local hooding	1,620,000
	TOTAL INSTALLED COST	$5,050,000

Notes:

1. Costs given for the 4th quarter 1982. Calculated using January 1981 costs and adding 32 percent for inflation.
2. Cost based on information from Sumitomo Heavy Industries, Ltd.
3. Costs include spare parts.

TABLE 4-5. Installation of REP--Operating Costs

1.	Maintenance, 2 percent of installed cost	$100,000
2.	Operators, 1 man per shift @ $40,000*	160,000
3.	Electrical power at $0.05 per KWH	83,000
4.	Service water at $.25 per 1000 gal.	36,000
5.	Depreciation, 20 year straight line	250,000
6.	Insurance, 1 percent of investment	50,000
	TOTAL ANNUAL OPERATING COST	$679,000

*Labor cost includes 25 percent fringe benefits, escalated to 3rd quarter 1982.

The estimates for electrical, process piping and structural reinforcement are given in Tables 4-1 through 4-3. In preparing them, the costs were calculated using the technical information that appears on the appropriate drawings. Each estimate includes a contingency factor of 15 percent.

The estimate for providing and erecting the precipitators is derived from cost data which is included in the specification by Sumitomo Heavy Industries. These costs were developed for the Chiba Works of the Kawasaki Steel Corporation, an REP facility which is very similar to the one under consideration. The REP costs that appear in the cost summary, Table 4-4, include escalation and also a 10 percent contingency factor.

In order to erect the precipitator and its supporting steelwork, access to the existing BOF building is proposed from the east side of the building. Preliminary investigations indicate that there is room at this location to position a crane for direct lifting and mounting of fabrications and components. There will be some interference with railroad movements on the tracks at ground level, but this was not deemed to be an insurmountable problem.

In general the costs were calculated using conservative methods of costing as well as conservative values for escalation and for contingencies. Thus, it is reasonable to utilize the cost values of $5,050,000 for installation and $679,000 for annual operation.

4.7 EXPECTED PERFORMANCE OF REPs

With respect to performance of the REPs, the critical furnace operation is expected to be hot metal charging. Depending on scrap quality and its impurities, hot metal charging is expected to provide the most severe test of REP performance. Tapping typically generates less intensive emissions spread over a longer time than charging, but can be as high as charging on occasion. Emissions during scrap charge, turndown (for sampling and temperature measurement), puffing (during blowing), and vessel deslagging are relatively low. Provided these latter emissions are directed (by means of partitions and baffles) to the REPs, they should easily be collected.

The REP specifications received from Sumitomo Heavy Industries provides a guarantee of 91.5 percent efficiency when the inlet concentration exceeds 0.4 g/dscm (0.175 gr/dscf). At or below the design inlet concentration of

0.4 g/scm the guaranteed outlet concentration is not to exceed 0.034 g/dscm (0.015 gr/dscf).

Relating the above performance guarantee to the needs of the BOF being considered is complicated by the fact that regulations and consent decrees applying to BOF fugitive emissions are written in terms of visible emissions from the roof monitor. A theoretical basis does exist for relating emission concentration to plume opacity and that relation will be used in this examination of expected performance. However, it is important to keep in mind the conversion of concentrations to visible emissions is not a well defined science.

To estimate the performance of the REPs as applied to this plant it is necessary to make several assumptions. Should a decision to proceed with a particular REP installation be made, some additional design data to verify or alter these assumptions will have to be obtained.

1) No measurements of uncontrolled furnace fugitive emission rates were available for this study; therefore, typical emission factors for charging were assumed.

2) No measurements of gas flow rate discharged from the roof monitor were available for this study. For the purposes of these calculations, the gas rate specified for the precipitator design (based on Japanese plant experience) was assumed to be the rate of gas discharge during hot metal charging operations. It is possible to develop an estimate of flow based on theoretical considerations. The technique is presented in Appendix A.

3) The upper building (within the partition walls) will act as a reservoir for the sudden fume emissions from hot metal charging. It is desirable to maintain a minimum time for hot metal charging, assumed to be two minutes. When coupled with the reservoir effect, it is assumed the hot metal charging emissions will pass through the precipitators over a three-minute period.

4) It is assumed that all the hot metal charging emissions from charging one furnace will pass through one precipitator. (As will be shown later it is desirable to divert, actively or passively, some portion to the other precipitator to reduce the dust load on a single precipitator.)

Using the above assumptions, the following calculations estimate the performance of the REP installation during hot metal charging (anticipated worst case). The emission factor for hot metal charging is 0.2 kg/tonne (0.4 lb/ton) of hot metal poured.[6] For a hot metal charge of 195 kg (215 tons) the particulate charging emissions are given as:

195 tonnes (0.2 kg/tonne) = 39 kg

The concentration of emissions entering the single REP is given as:

$$\frac{39 \text{ kg/chg } (1{,}000 \text{ grams/kg})}{13{,}500 \text{ acms } (3 \text{ min/chg})} = 0.96 \text{ g/acm } (0.42 \text{ gr/acf})$$

Assuming an efficiency of 91.5 percent gives an average outlet concentration during the hot metal charge of:

(1.0 - .915)(0.92) = 0.082 gr/acm (0.036 gr/acf)

The concentration at which the plume opacity will equal 20 percent is estimated as follows:[7]

$$W = \frac{-\rho K \ln(I/I_0)}{L}$$

where:

W = concentration (grams/m^3)

L = light path length through plume (meters)

ρ = density of particles (grams/cm^3)

K = specific particulate volume/extinction coefficient ratio (cm^3/m^2)

I/I_0 = light transmittance

For this case the variables having the following values:

L = 10 meters (distance across top of REP west to east)

ρ = 5 grams/cm^3 (iron oxide)

K = 1 to 2 cm^3/m^2 (iron oxide, mass mean radius of 5 microns[8], geometric standard deviation of 3 to 4)

I/I_o = 0.8 transmittance for 20 percent opacity

Therefore,

$$W = \frac{-5\ (1\ \text{to}\ 2) \ln (0.8)}{10}$$

$$= 0.112\ \text{to}\ 0.223\ \text{gr/acm}$$
$$= 0.049\ \text{to}\ 0.097\ \text{gr/acf}$$

The estimated outlet concentration based on 91.5 percent efficiency is 0.082 gr/acm (0.036 gr/acf). On a theoretical basis the REP installation appears to be able to achieve a discharge opacity less than 20 percent during hot metal charging. The cautions with respect to the estimating methodology must be recalled at this point. However, the hot metal charge represents the most difficult collection problem, and the other portions of the furnace cycle should be much better in terms of visible emissions.

An additional essential point of discussion with respect to performance is that Sumitomo Heavy Industries recommends the use of a local secondary hood (probably a charging hood) to reduce the total load of particulate going to the REP during charging, if it is desired to maintain 0.034 g/scm (0.015 gr/scf). The two BOF installations of Kawasaki Steel do have this feature. The Japanese also state that lack of a local secondary hood will cause dirtier in-plant conditions than in their plants due to dust fallout. However, one would not expect the REPs to substantially alter the in-plant conditions as compared to present operations, which are assumed to have no secondary control. Should lower discharge concentrations be desired during hot metal charging two alternatives are possible. As was suggested previously in this section, provisions can be made to divert a portion of the charge emissions to the adjacent REP by means of partitions and baffling. A fan assist might even be tried. The second alternative is to provide larger REPs with higher efficiency than those in the specifications. This latter alternative is consistent with the Japanese recommendation of larger REPs if no local secondary hoods are provided.

5.0 VISIBLE EMISSIONS PERFORMANCE EVALUATION OF ROOF-MOUNTED ELECTROSTATIC PRECIPITATORS APPLIED TO AN ELECTRIC ARC FURNACE

Upon selecting REPs as a promising foreign technology for control of fugitive emissions, permission to conduct performance evaluations was requested from the Japanese steel firms. The first choice for performance evaluation was the Q-BOP at Chiba Works of Kawasaki Steel. The initial plan for performance evaluation was to conduct mass emission tests and use photographic techniques to evaluate fume capture effectiveness. Even though the REP manufacturer, Sumitomo Heavy Industries, supported the request for performance evaluation, Kawasaki Steel declined to participate. Concerned that the initial performance evaluation plan required too much effort and involvement of Kawasaki Steel personnel, the plan was revised to include only visible emissions (VE) evaluation. The modified plan, however, was also refused. Numerous other attempts at obtaining permission to evaluate REPs applied to BOFs were also unsuccessful.

Though the emphasis in this project was intended to be placed on BOF fugitive emission control, at this point it was clear any performance evaluation would have to be made on another source type. Sumitomo Metal Mining Company was approached about evaluation of REPs applied to EAF steelmaking. After some negotiations SMM arranged for a visible emission evaluation to be performed at a Tokyo Steel facility.

5.1 PLANT DESCRIPTION AND OPERATIONS

The Tokyo Steel plant in which this measurement program was performed is located in Hachinohe, a city in Aomori Prefecture on Honshu Island. The plant produces reinforcing bar and building steel on a plant site of 237,000 m^2 area. The raw steel production facilities consist of one electric arc furnace (EAF) of 70 tonne design capacity per cycle. However, the actual charge rate is about 100 tonnes per cycle. The plant is shut down one day per week for maintenance. On a monthly basis, the furnace capacity is 36,000 tonnes with a plant product capacity of 30,000 tonnes. The raw steel is continuously cast in a five strand caster that operates about fifteen to twenty hours per day. The current average raw steel production rate is 27,000 tonnes per month with a finished product rate of 15,000 tonnes per month. The remaining raw steel is being sold to other steel finishers.

The design electrical input to the furnace is 30,000 kVA, but actual input is 36,000 to 40,000 kVA. The furnace cycle time, tap to tap, is about 95 minutes. Typically 14 to 15 heats are produced each day.

The relatively short cycle times result from several operating practices. Firstly, scrap is preheated prior to charging to the furnace. The scrap preheat is accomplished by passing the hot furnace waste gas stream through a charging bucket containing the scrap. Scrap is charged to the furnace in three batches. The first charge is about 45 tonnes; the second is 35 tonnes; and the third is 20 tonnes. Each of these batches is preheated for about 20 minutes prior to charging. The charge material is mostly automobile and heavy scrap. Secondly, OF burners (oil and oxygen) are used to increase the rate of scrap melting in the furnace. Three burners rated at 500 liters per hour each are used. Thirdly, pure oxygen is used to cut scrap added to the furnace after the third scrap charge.

5.2 AIR POLLUTION CONTROL SYTEMS

The electric arc furnace was constructed with a direct shell evacuation system for fume control during melting and refining operations. The evacuation rate is about 1,300 sm^3/min or 2500 m^3/min at 250°C. Particulate control in this system is achieved by a baghouse.

As mentioned previously, this waste gas stream is used to preheat scrap. The gas stream temperature leaving the furnace is about 800°C. After initial evaporative cooling, it enters the scrap at about 400°C. The gas temperature leaving the scrap is about 130°C. Fugitive dust control for furnace charging and tapping operations is provided by a roof-mounted electrostatic precipitator (REP). The REP is located above the furnace as shown in Figure 5-1. Partition walls attached to the roof trusses, and a sealed roof form a hood to contain the fugitive emissions and direct them to the REP inlet. The roof areas on the opposite side of the partition walls are not sealed and are vented through natural draft ventilators.

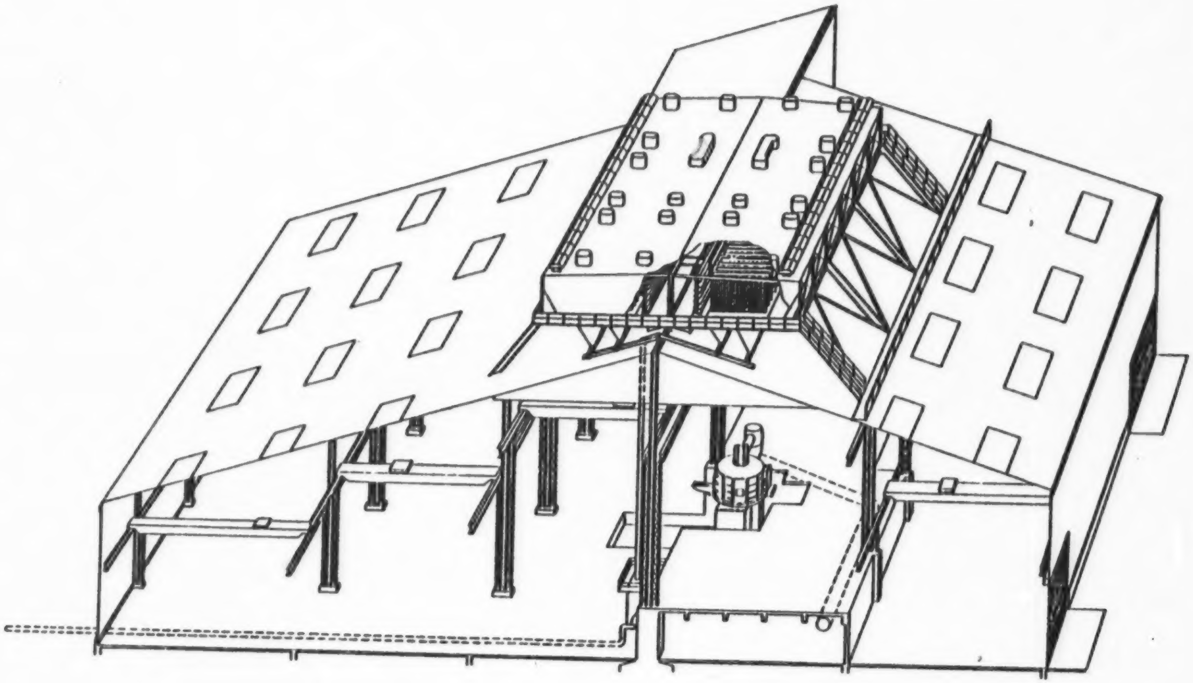


FIGURE 5-1. Tokyo Steel EAF Shop.

The REP installation consists of six precipitator chambers, constructed in two groups of three adjacent chambers as shown in Figure 5-2. Electrically each chamber is a single section powered by an 800 mA, 80 kV RMS (120 kV peak) transformer-rectifier set.

The collecting electrodes are carbon steel with a plate to plate spacing of 400 mm. The discharge electrodes are of rigid frame design constructed from 304 stainless steel, with a wire to wire spacing of 250 mm. The "wires" are actually square rods 4 mm on a side. Total collecting plate surface area is 10,188 m^2 for the installation.

The elevation view shown in Figure 5-2 reveals that gas flow through the precipitator is horizontal. Turning vanes to accomplish this direction change increase the static pressure drop through the REP making fan assistance to natural thermal draft essential. The flow dampers in the REP were set to achieve the design flow of 960,000 m^3/h without the furnace in operation. The static pressure drop through the REP has been measured at about 30 mm H_2O (1.2 in H_2O). Propeller fans at each stub stack consume about 2.2 kWh per fan. Dry collecting plate and discharge electrode cleaning is performed by an internal "hammer type" arrangement. The cleaning cycle time is about five minutes. Dust is collected in pyramid hoppers and removed by chain conveyors.

Design conditions for the REP are as follows:

Gas flow rate - 960,000 m^3/h
Gas temperature - 30 to 80°C
Inlet dust concentration - $\leq$ 1 g/scm (0.44 gr/scf)
Outlet dust concentration - 0.03 g/scm (0.013 gr/scf)

Actual average inlet concentration measurements have varied between 0.15 and 0.5 g/scm. Source instantaneous measurements have revealed inlet concentrations above 1 g/scm. In 1975, the actual average outlet concentration was measured at 0.012 g/scm. In 1982, the average of two outlet concentration measurements was 0.018 g/scm.

Sumitomo Metal Mining attributes the increase in outlet concentration between 1975 and 1982 to increased concentrations of lead and zinc oxides in the EAF dust. In dust samples taken at both times, the measured zinc oxide

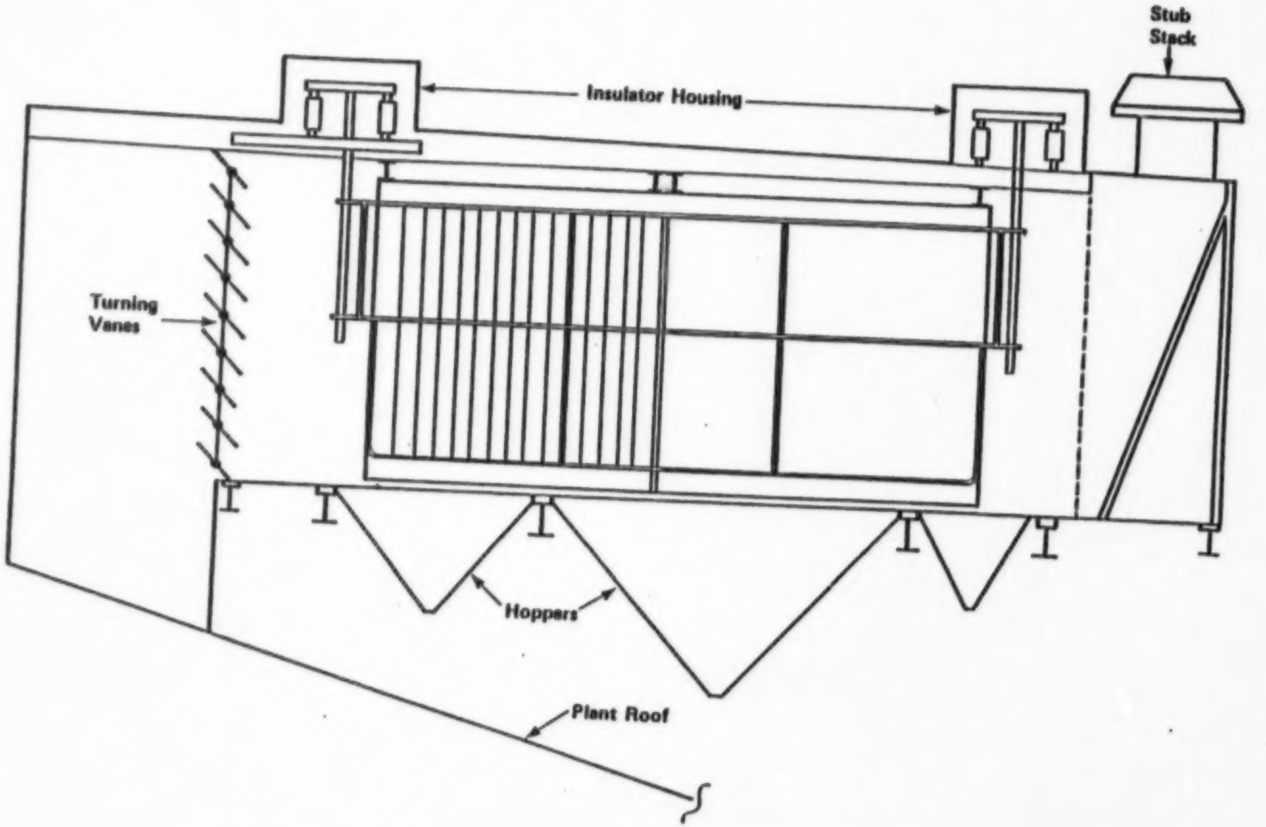

Stub
Stack
Insulator Housing
Turning
Vanes
Hoppers
Plant Roof

FIGURE 5-2. Elevation View of REP.

concentration increased from 4% to 25%. Electrical resistivity measurements showed an increase from 2 x 10^{11} ohm-cm to 2.5 x 10^{13} ohm-cm. The outlet concentration measurements were obtained by the Japanese standard test method JIS Z 8808. Each measurement consisted of the average results for five stacks i.e., one precipitator chamber. The samples were obtained at the center point of the gas stream in each stack. The test probe was an "in-stack filter" constructed of glass. The filtering media was silica glass wool.

Inlet dust concentrations were measured at many points across the REP entrance. Instantaneous inlets were measured with the equivalent of a U.S. high volume sampler.

5.3 VISIBLE EMISSION OBSERVATIONS PROCEDURE

Visible emissions (VE) observations were preformed over a five-day period beginning November 5, 1982. Figure 5-3 is a plan diagram of the plant adjacent to the EAF shop showing the locations in which VE data were gathered.

The relative elevation of the REP stub stacks with respect to the observer's locations, and the building and REP geometry permitted viewing of one set of stub stacks (15 on a side) at a time. Consideration of the sun angle and the lack of any mostly cloudy days limited the observations to the south-side set of 15 stub stacks. Because the EAF centerline was located under the south-side REP chambers, and the more concentrated emissions tended to rise directly to the south-side inlet, it may be stated that the observations were performed on the more severly challenged portion of the REP. This statement is further reinforced by the fact that the scrap preheating operation and the route of scrap charging bucket movement to the EAF (usually smoking) was located under the south-side REP.

The VE observations of the REP stub stacks were performed in accordance with EPA Method 9. Two observers simultaneously observed the same emission points recording the most opaque emissions issuing from the stub stacks. Observation positions were changed during the day to maintain an acceptable sun angle and adjust to changes in wind direction.

Adjacent to the REP on both the east and west sides, but at lower elevation, were natural draft building ventilator discharge areas. Visible emissions from these ventilators were noted on the data sheets, but not officially

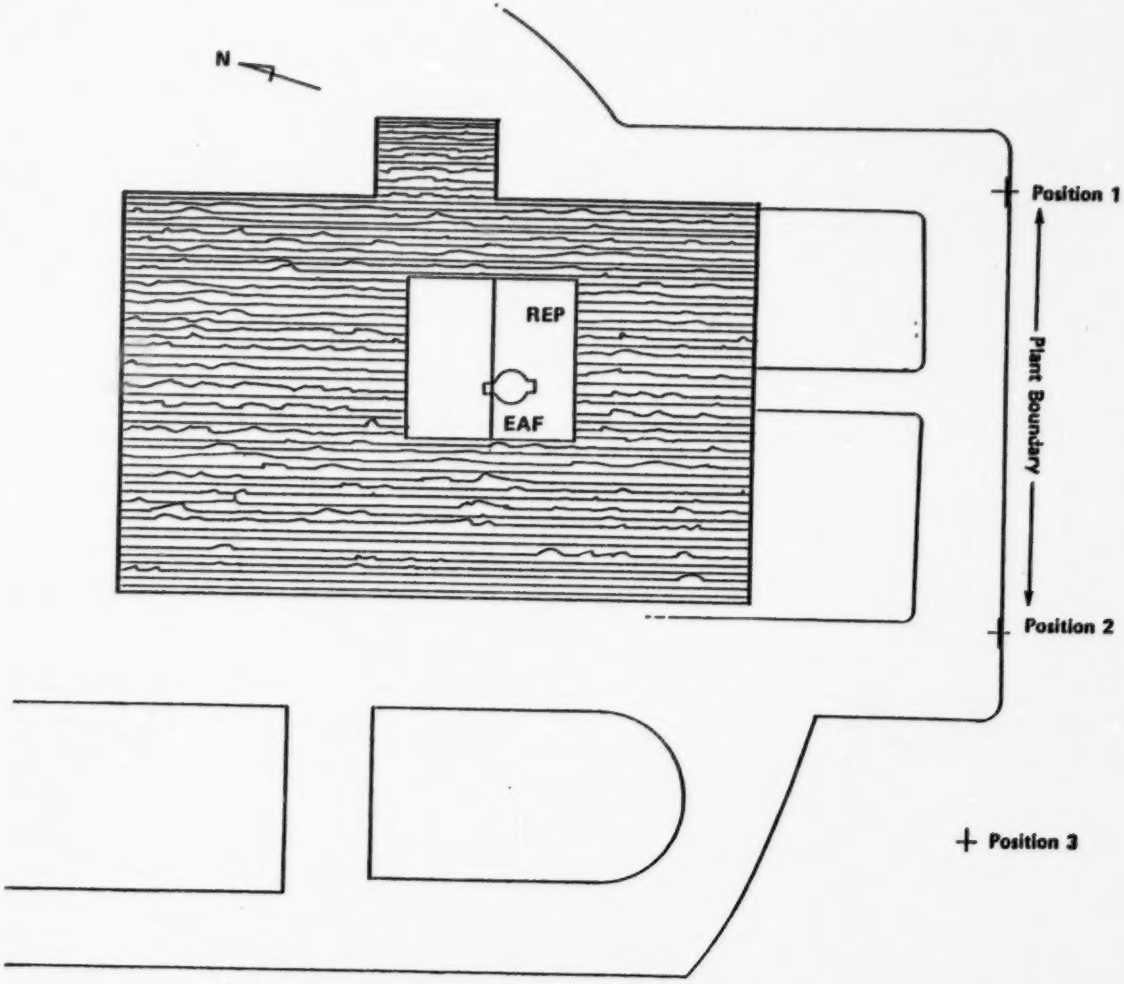

N
REP
EAF
Position 1
Plant Boundary
Position 2
Position 3

FIGURE 5-3. Plan View of EAF Shop and Observer Locations.

recorded, since only the REP discharges were of interest. On several occasions during the observation period these ventilator discharges mixed with the REP stub stack discharges. On these occasions when mixing could be identified, interferences were recorded on the VE data sheets.

In a similar manner, sometimes discharges from the north-side REP stub stacks rose in the background of the south-side stub stacks discharges causing the observer to look through two plumes. When it was possible to clearly identify these occurrences, they were also noted as interferences.

Concurrent with external VE observations, process data were taken and estimates of in-shop fugitive emission intensity were made. The in-shop emission intensity was characterized in two ways. First, the fugitive emissions emanating from the furnace were classified as light, moderate, or heavy. Second, every two minutes the opacity of emissions in the roof area around the REP inlet was estimated. Because there is no reference method for reading plume opacity inside buildings and poor lighting conditions exist at times, no significant quantitative meaning should be inferred from the latter estimates. However, the in-shop estimates can be used to indicate the relative dust load being treated by the REP at various times in the furnace cycle. Also, the REP stub stack emissions can be studied with reference to the level of inlet dust load as well as process operations occurring.

5.4 DATA ANALYSES

To facilitate analyses of VE data the EPA Method 9 data were put into a computer file. Consecutive six-minute average opacities were computed for each data set (each day and each observer group) beginning with the first reading of the day. With the data computerized, twenty-three other sets of consecutive six-minute averages can be computed for each data set relatively easily. However, this was not done because a review of manually calculated moving averages suggested such an analysis would not significantly alter the general trend of results. The raw data are provided in Appendix B.

An index of REP inlet dust concentration was computed using the estimates of roof area opacity taken every two minutes. For the purposes of this analysis, each two-minute reading was presumed to be the inlet opacity for the two-minute period beginning when the reading was recorded. The index was computed by multiplying estimated opacity by the number of minutes over which it applied. For example, if the inlet opacity was estimated at 100% over the entire six-minute period for which the outlet opacity was computed, the inlet index was 600 (the maximum possible inlet index). If, as in some cases, there was not an inlet opacity estimate available for the entire six-minute period, the index was adjusted to a six-minute basis, and the minutes of data for which the index was computed were listed beside the index.

To facilitate planned ESP computer model computations, REP electrical data were recorded periodically during the test program. Transformer secondary current and voltage readings were recorded. These data were put into a computer file. Current densities and corona power were computed for each chamber of the REP for each set of readings.

5.5 DISCUSSION OF TEST RESULTS

About 30 hours of VE data were obtained at Tokyo Steel. Table 5-1 provides a cumulative frequency distribution summary of the six-minute VE averages. As is evident, no six-minute average exceeded 16% opacity for either observer group. Less than one percent of the six-minute averages exceeded 10% opacity for either observer group. Approximately five percent of the averages for both observer groups exceeded 6% opacity.

The significance of the 6% opacity level is that it is a proposed revision for the EAF New Source Performance Standards (NSPS). The proposed standard requires EAF roof monitor or building visible emissions not to exceed 6% opacity during any phases of operation.

While a direct comparison between the Tokyo Steel REP visible emission data and this NSPS scenario is one measure of the REP's potential for achieving particulate control equivalent to the best demonstrated U.S. technology, other factors must be considered as well. Among these other factors are comparison of Tokyo Steel EAF operating practice with U.S. EAF practice; design conditions for the Tokyo Steel REP as compared to actual operating conditions; and consideration of furnace operator training and its potential effect on inlet dust concentrations to the REP.

The Tokyo Steel EAF operating practice was described briefly in Section 5.1 of this report. An initial scrap charge is followed by two backcharges

TABLE 5-1 Cumulative Frequency Distribution
Six-Minute Average Opacities
Tokyo Steel - Hachinohe Works
November 5-9, 1982

	Observer Group 1		Observer Group 2	
Opacity %	Number of Readings Less Than or Equal	% of Readings Less Than or Equal	Number of Readings Less Than or Equal	% of Readings Less Than or Equal
0	108	35.8	111	37.2
1	167	55.3	174	58.4
2	203	67.2	207	69.5
3	237	78.5	235	78.9
4	254	84.1	258	86.6
5	281	93.0	274	91.9
6	287	95.0	281	94.3
7	292	96.7	290	97.3
8	300	99.3	294	98.7
9	300	99.3	294	98.7
10	300	99.3	295	99.0
15	301	99.7	297	99.7
20	302	100	298	100
	Highest Average Opacity - 16.0%		Highest Average Opacity - 16.0%	

all of which are preheated scrap. The third scrap charge is followed immediately by a scrap cutting operation using oxygen lances. Oxygen lances are also used during the refining period preceding tapping. The average tap-to-tap furnace cycle time during the tests was 97 minutes. The various cycle intervals are listed in Table 5-2. The draft Background Information Document for the EAF NSPS revisions describe typical EAF cycles as 1 to 5 hours in duration, placing Tokyo Steel practice at the high rate end of the scale.

TABLE 5-2 Tokyo Steel EAF Operation Durations

Interval	Average Duration-Minutes
Cycle, Tap-to-Tap	97
Tap-Begin Charge 1	9
End Charge 1-Begin Charge 2	24
End Charge 2-Begin Charge 3	17
End Charge 3-End Scrap Cut	14
End Scrap Cut-Begin Tap	30

The practice of backcharging twice is a factor tending to increase fugitive emissions, or the particulate load to a fugitive dust control system. Use of OF burners might increase fugitive furnace emissions if they were installed subsequent to the design of the furnace waste gas system. However, because the increased waste gas volume due to OF burners represents only about five percent of the waste gas flow at Tokyo Steel, OF burners are probably not a significant fugitive emission factor. The practice of scrap cutting following the second backcharge also tends to increase fugitive furnace emissions. Fugitive furnace emissions increase during scrap cutting due to tilting of the furnace, causing misalignment between the baghouse offtake duct and the direct shell evacuation duct on the furnace. The furnace is tilted to move the pool of molten metal to the front or rear of the furnace. This speeds the melting of the scrap being cut. The degree of duct misalignment varies and may be minimized by a skillful operator concerned for the effect on fugitive emissions.

The specific furnace operating practices for those EAFs in the NSPS data base are not described in the Background Information Document. Therefore, a direct comparison is not possible. Some general comments about U.S. furnace practice may be made. At present no EAF shops have completed waste gas scrap preheating installations. A few are in progress.[9] Use of OF burners is also not widely practiced. Probably less than five percent of the furnaces are equipped with these, but there may be a trend toward widespread use in domestic installations.[6] Furnace tilting following scrap charging is not known to be commonly practiced due to the risk of scrap shifting and damaging the carbon electrodes.

Presuming the Tokyo Steel scrap quality to be typical of U.S. practice (Tokyo Steel plant operators complained of having to use poor quality U.S. scrap), the other factors of cycle time, backcharging, fugitive smoke from the preheated scrap in the charging bucket, and scrap cutting with furnace tilting place Toyko Steel in a category of higher potential fugitive emissions. Consequently, Tokyo Steel represents a relatively difficult control situation for the REP as compared to present U.S. practice.

Given that U.S. furnace practice may also change, it is appropriate to examine steps that might lead to improved REP performance. This can be done by examining the opacity data in more detail.

Tables 5-3 through 5-12 present the six-minute average opacities for each day and each observer group. The time column is the hour, minute, and second at which the twenty-fourth reading of the average was taken. The center column lists furnace operations and their time of occurrence. The basis for and interpretation of the inlet index has been described previously in Section 5.4.

The daily mean values of six-minute opacities varied from a low value of 0.2% on November 5 to a high value of 2.1% on November 9. Inspection of these tables reveals that all the six-minute average opacities that exceed 6% opacity occurred during the second and third scrap charges (first and second back-charges), scrap cutting, and in the period just before tapping. The two occurrences preceding tapping, on November 6 and 7, may be attributable to operator inexperience or error. The heavy furnace fugitive discharges preceding tapping on November 7 were partially a result of early retraction of the connecting duct section between the furnace direct shell evacuation duct and

TABLE 5-3 TOKYO STEEL VE DATA

NOVEMBER 5 , 1982

OBSERVER GROUP-KLOTZ/COY/KLOTZ

			ESP OUTLET		ESP INLET	
HR	TIME MIN	SEC	CONSECUTIVE SIX-MINUTE AVG OPACITY-%	FURNACE OPERATIONS	INLET INDEX OPAC-MIN	MINUTES OF DATA ON WHICH INLET IS BASED
13	56	45	0.0		0	2.0
14	2	45	0.0		120	6.0
14	8	45	0.0		100	6.0
14	14	45	0.0		70	6.0
14	20	45	0.0	TAP 14:19-14:22	210	6.0
14	26	45	0.2	TAP 14:19-14:22	140	6.0
14	32	45	0.4		0	6.0
14	38	45	0.0		0	6.0
14	45	0	0.0		0	6.0
14	51	0	0.0		0	6.0
14	57	0	0.0		0	6.0
15	3	0	0.0	CHARGE 1 15:00-15:01	203	6.0
15	9	0	0.0		40	6.0
15	15	0	0.0		49	6.0
15	21	30	0.0		51	6.0
15	28	45	1.9	CHARGE 2 15:27-15:29	428	6.0
15	35	30	1.0		139	6.0
15	41	30	0.0		34	6.0
15	47	30	0.0		188	6.0
15	54	30	0.6	CHARGE 3 15:48-15:50	329	6.0

ESP OUTLET SUMMARY STATISTICS

NUMBER OF AVG'S	MAX AVG	MEAN	STANDARD DEVIATION
20	1.9	0.2	0.48

TABLE 5-4 TOKYO STEEL VE DATA

NOVEMBER 5 , 1982

OBSERVER GROUP-GOLDMAN/COY/GOLDMAN

			ESP OUTLET		ESP INLET	
HR	TIME MIN	SEC	CONSECUTIVE SIX-MINUTE AVG OPACITY-%	FURNACE OPERATIONS	INLET INDEX OPAC-MIN	MINUTES OF DATA ON WHICH INLET IS BASED
13	56	45	0.0		0	2.0
14	2	45	0.0		120	6.0
14	8	45	0.0		100	6.0
14	14	45	0.0		70	6.0
14	20	45	0.0	TAP 14:19-14:22	210	6.0
14	26	45	0.0	TAP 14:19-14:22	140	6.0
14	32	45	0.2		0	6.0
14	38	45	0.0		0	6.0
14	44	45	0.0		0	6.0
14	50	45	0.0		0	6.0
14	56	45	0.0		0	6.0
15	2	45	0.0	CHARGE 1 15:00-15:01	200	6.0
15	8	45	0.0		40	6.0
15	15	0	0.0		50	6.0
15	21	15	0.0		51	6.0
15	28	15	1.3	CHARGE 2 15:27-15:29	405	6.0
15	35	0	1.0		186	6.0
15	41	0	0.0		31	6.0
15	47	0	0.0		143	6.0
15	56	0	0.8	CHARGE 3 15:48-15:50	274	6.0

ESP OUTLET SUMMARY STATISTICS

NUMBER OF AVG'S	MAX AVG	MEAN	STANDARD DEVIATION
20	1.3	0.2	0.39

TABLE 5-5 TOKYO STEEL VE DATA

NOVEMBER 6 . 1982

OBSERVER GROUP-KLOTZ/BRANSCOME/KLOTZ

ESP OUTLET					ESP INLET	
HR	TIME MIN	SEC	CONSECUTIVE SIX-MINUTE AVG OPACITY-%	FURNACE OPERATIONS	INLET INDEX OPAC-MIN	MINUTES OF DATA ON WHICH INLET IS BASED
8	35	45	0.6	CHARGE 1 8:31-8:33	270	5.0
8	41	45	0.0		25	6.0
8	47	45	0.0		0	6.0
8	53	45	0.0		15	6.0
8	59	45	2.3		335	6.0
9	5	45	7.1	CHARGE 2 9:01-9:02	520	6.0
9	11	45	4.2		330	6.0
9	17	45	4.4		500	6.0
9	24	0	2.1	CHARGE 3 9:18-9:21	564	6.0
9	30	15	1.3		318	6.0
9	36	15	4.6		450	6.0
9	42	15	2.5	END CUTTING 9:37	400	4.5
9	48	15	0.2		11	5.5
9	54	15	0.0		15	6.0
10	0	15	0.0		45	6.0
10	6	15	0.2	TAP 10:02-10:07	75	6.0
10	12	15	0.0	CHARGE 1 10:10-10:11	103	6.0
10	18	15	0.0		13	6.0
10	24	15	0.0		0	6.0
10	30	15	0.0		8	6.0
10	36	15	1.7		118	6.0
10	42	15	4.4	CHARGE 2 10:38-10:39	405	6.0
10	48	15	0.0		0	6.0
10	54	15	0.6		0	6.0
11	0	15	6.5	CHARGE 3 10:56-10:57	330	6.0
11	6	15	3.3		40	4.5
11	12	15	6.9	END CUTTING 11:09	584	5.5
11	18	15	2.1		83	4.0
11	24	15	0.4		0	6.0
11	30	45	0.4		110	6.0
11	36	45	0.0		10	6.0
11	43	30	1.7	TAP 11:40-11:45	173	6.0
13	43	30	1.7	TAP 11:40-11:45	600	3.3
13	50	0	4.4	CHARGE 2 13:46-13:47	0	1.3
13	56	0	0.0		0	6.0
14	2	0	2.7	CHARGE 3 14:02-14:03	126	4.8
14	8	15	4.2		350	5.3

TABLE 5-5 (continued)

```
14   14   15          2.3
14   20   15          6.0                             98         6.0
14   26   15          4.4     END CUTTING 14:15     365         6.0
14   32   15          2.5                           275         6.0
14   38   15          2.3                           240         6.0
14   44   45          7.1                           250         6.0
14   50   45          2.5                           325         6.0
14   56   45          0.8     TAP 14:46-14:47       420         6.0
15    2   45          0.0     CHARGE 1 14:51        200-        6.0
15    8   45          0.0                            10         6.0
15   14   45          1.0                            60         6.0
15   20   45          4.0                             0         6.0
15   26   45          0.0     CHARGE 2 15:17-15:18  240         6.0
15   32   45          0.0                            70         6.0
15   38   45          3.3                            90         6.0
15   44   45          1.0     CHARGE 3 15:35-15:36  360         6.0
15   50   45          2.1                           420         6.0
15   56   45          0.0     END CUTTING 15:48     360         6.0
16    2   45          0.0                           160         6.0
16    8   45          2.5                           120         6.0
16   14   45          1.0                           140         6.0
                                                    240         6.0
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                    ESP OUTLET SUMMARY STATISTICS
                    -----------------------------
NUMBER OF AVG'S      MAX AVG   MEAN      STANDARD DEVIATION
      58               7.1     2.0             2.10
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TABLE 5-6 TOKYO STEEL VE DATA

NOVEMBER 6 . 1982

OBSERVER GROUP-COY/BRANSCOME/COY

ESP OUTLET					ESP INLET	
HR	TIME MIN	SEC	CONSECUTIVE SIX-MINUTE AVG OPACITY-%	FURNACE OPERATIONS	INLET INDEX OPAC-MIN	MINUTES OF DATA ON WHICH INLET IS BASED
8	35	45	0.4	CHARGE 1 8:31-8:33	270	5.0
8	41	45	0.0		25	6.0
8	47	45	0.0		0	6.0
8	53	45	0.0		15	6.0
8	59	45	2.5		335	6.0
9	5	45	6.7	CHARGE 2 9:01-9:02	520	6.0
9	11	45	3.5		330	6.0
9	17	45	4.4		500	6.0
9	24	0	2.5	CHARGE 3 9:18-9:21	564	6.0
9	30	15	1.5		331	6.0
9	36	15	3.5		450	6.0
9	42	15	1.9	END CUTTING 9:37	400	4.5
9	48	15	0.2		11	5.5
9	54	15	0.0		15	6.0
10	0	15	0.0		45	6.0
10	6	15	0.0	TAP 10:02-10:07	75	6.0
10	12	15	0.0	CHARGE 1 10:10-10:11	103	6.0
10	18	15	0.0		13	6.0
10	24	15	0.0		0	6.0
10	30	15	0.0		8	6.0
10	36	15	1.7		118	6.0
10	42	15	4.2	CHARGE 2 10:38-10:39	405	6.0
10	48	15	0.0		0	6.0
10	54	15	0.6		0	6.0
11	0	15	7.7	CHARGE 3 10:56-10:57	330	6.0
11	6	15	0.8		40	4.5
11	12	15	7.3	END CUTTING 11:09	584	5.5
11	18	15	1.5		83	4.0
11	24	15	0.4		0	6.0
11	30	15	1.9		110	6.0
11	36	15	0.0		20	6.0
11	43	0	1.3	TAP 11:40-11:45	123	6.0
13	43	30	1.5	TAP 11:40-11:45	600	3.5
13	49	45	3.8	CHARGE 2 13:46-13:47	0	1.0
13	55	45	0.0		0	6.0
14	1	45	2.3		120	5.0
14	8	0	4.0	CHARGE 3 14:02-14:03	366	5.0
14	14	0	1.5		86	6.0

TABLE 5-6 (continued)

14	20	0	5.0	END CUTTING 14:15	368	6.0
14	26	0	4.0		273	6.0
14	32	15	1.9		240	6.0
14	38	15	2.1		250	6.0
14	44	45	6.7		325	6.0
14	50	45	2.9	TAP 14:46-14:47	420	6.0
14	56	45	0.2	CHARGE 1 14:51	200	6.0
15	2	45	0.0		10	6.0
15	8	45	0.0		60	6.0
15	14	45	1.0		0	6.0
15	20	45	5.2	CHARGE 2 15:17-15:18	240	6.0
15	26	45	0.0		70	6.0
15	32	45	0.0		90	6.0
15	53	15	0.6	CHARGE 3 15:35-15:36	240	6.0
15	59	15	0.0		65	6.0
16	5	15	0.8		120	6.0
16	11	15	1.9		190	6.0

ESP OUTLET SUMMARY STATISTICS

NUMBER OF AVG'S	MAX AVG	MEAN	STANDARD DEVIATION
55	7.7	1.8	2.11

TABLE 5-7 TOKYO STEEL VE DATA

NOVEMBER 7 . 1982

OBSERVER GROUP-KLOTZ/COY/KLOTZ

HR	TIME MIN	SEC	ESP OUTLET CONSECUTIVE SIX-MINUTE AVG OPACITY-%	FURNACE OPERATIONS	ESP INLET INLET INDEX OPAC-MIN	MINUTES OF DATA ON WHICH INLET IS BASED
8	27	45	0.0		108	5.0
8	34	0	2.5	CHARGE 2 8:30-8:31	158	6.0
8	40	0	0.0		24	6.0
8	46	0	0.0		39	6.0
8	52	0	1.9	CHARGE 3 8:48-8:49	313	6.0
8	58	15	1.3		253	6.0
9	4	15	0.0	END CUTTING 8:59	70	6.0
9	10	15	1.0		60	6.0
9	16	15	0.0		25	6.0
9	22	15	0.0		85	6.0
9	28	15	0.2		103	6.0
9	34	30	0.0		49	6.0
9	40	30	0.0		10	6.0
9	46	30	1.9		386	6.0
9	52	30	0.0	TAP 9:47-9:50	513	6.0
9	58	30	0.0		41	6.0
10	4	30	0.0		1	6.0
10	10	30	0.0		0	6.0
10	28	30	0.0	CHARGE 1 10:26-10:27	53	6.0
10	34	30	0.0		18	6.0
10	40	30	0.0		0	6.0
10	46	30	0.0		26	6.0
10	52	30	1.3	CHARGE 2 10:48-10:49	421	6.0
10	58	30	0.0		13	6.0
11	4	30	0.0		39	6.0
11	10	30	0.6	CHARGE 3 11:07-11:08	276	6.0
11	16	30	0.0		178	6.0
11	22	30	0.8		313	6.0
11	28	30	0.2	END CUTTING 11:24	263	6.0
11	34	30	0.0		61	6.0
11	40	30	0.0		49	6.0
11	46	30	0.0		68	6.0
11	52	30	0.0		74	6.0
11	58	30	0.0	TAP 11:53-11:55	211	6.0
12	4	30	0.0	CHARGE 1 12:00-12:01	130	6.0
12	10	30	0.0		0	6.0

TABLE 5-7 (continued)

12	16	30	0.0		0	6.0
12	22	30	0.2		35	6.0
12	28	30	5.0	CHARGE 2 12:25-12:27	480	6.0
12	34	30	0.0		55	6.0
12	40	30	0.0		0	6.0
12	47	15	1.9	CHARGE 3 12:44-12:45	195	6.0
12	53	15	1.7		190	6.0
12	59	15	4.8	END CUTTING 12:58	590	6.0
13	5	15	4.4		480	6.0
13	11	15	1.7		275	6.0
13	17	15	1.5		130	6.0
13	23	15	3.1	TAP 13:22-13:26	525	6.0
13	29	15	0.0	TAP 13:22-13:26	315	6.0
13	35	15	0.8		197	3.5
13	41	15	1.3		---	---
13	47	15	2.7		---	---
13	53	15	4.2		---	---
13	59	15	2.1		---	---
14	5	15	1.3		---	---
14	11	15	1.7		---	---
14	17	15	3.1	CHARGE 3 14:13	60	0.5
14	23	15	1.7		145	6.0
14	29	15	4.8	END CUTTING 14:25	245	6.0
14	35	15	5.0		255	6.0
14	41	15	5.0		185	6.0
14	47	30	7.1		375	6.0
14	53	30	7.5		315	6.0
14	59	30	3.5	TAP 14:54-14:58	343	6.0
15	5	30	0.0	CHARGE 1 15:03	213	6.0
15	11	30	0.0		20	6.0
15	17	30	0.0		19	4.0
15	23	30	0.2		83	6.0
15	29	30	1.0	CHARGE 2 15:29-15:30	88	6.0
15	35	30	1.5		70	6.0
15	41	30	0.0		28	6.0
15	47	30	0.8		33	6.0

ESP OUTLET SUMMARY STATISTICS

NUMBER OF AVG'S	MAX AVG	MEAN	STANDARD DEVIATION
72	7.5	1.3	1.82

TABLE 5-8 TOKYO STEEL VE DATA

NOVEMBER 7 . 1982

OBSERVER GROUP-GOLDMAN/COY/GOLDMAN

HR	TIME MIN	SEC	ESP OUTLET CONSECUTIVE SIX-MINUTE AVG OPACITY-%	FURNACE OPERATIONS	ESP INLET INLET INDEX OPAC-MIN	MINUTES OF DATA ON WHICH INLET IS BASED
8	27	45	0.0		108	5.0
8	34	0	2.1	CHARGE 2 8:30-8:31	158	6.0
8	40	0	0.0		24	6.0
8	46	0	0.0		39	6.0
8	52	0	1.7	CHARGE 3 8:48-8:49	313	6.0
8	58	15	0.8		253	6.0
9	4	15	0.0	END CUTTING 8:59	70	6.0
9	10	15	0.6		60	6.0
9	16	15	0.0		25	6.0
9	22	15	0.0		85	6.0
9	28	15	0.0		103	6.0
9	34	15	0.0		50	6.0
9	40	15	0.2		10	6.0
9	46	15	2.3		363	6.0
9	52	15	0.4	TAP 9:47-9:50	525	6.0
9	58	15	0.0		53	6.0
10	4	15	0.0		3	6.0
10	10	15	0.0		0	6.0
10	30	15	0.0	CHARGE 1 10:26-10:27	8	6.0
10	36	15	0.0		3	6.0
10	42	15	0.0		0	6.0
10	48	15	0.0	CHARGE 2 10:48-10:49	180	6.0
10	54	15	0.4		278	6.0
11	0	15	0.0		10	6.0
11	6	15	0.0		63	6.0
11	12	15	0.2	CHARGE 3 11:07-11:08	325	6.0
11	18	15	0.0		180	6.0
11	24	15	0.4	END CUTTING 11:24	335	6.0
11	30	15	0.0		185	6.0
11	36	15	0.0		43	6.0
11	42	15	0.0		50	6.0
11	48	15	0.0		78	6.0
11	54	15	0.0	TAP 11:53-11:55	85	6.0
12	0	45	0.0	CHARGE 1 12:00-12:01	210	6.0
12	6	45	0.0		80	6.0

TABLE 5-8 (continued)

12	12	45	0.0		0	6.0
12	18	45	0.0		0	6.0
12	24	45	1.9		140	6.0
12	30	45	2.5	CHARGE 2 12:25-12:27	420	6.0
12	36	45	0.0		10	6.0
12	42	45	0.0		10	6.0
12	50	0	1.5	CHARGE 3 12:44-12:45	160	6.0
12	56	0	3.5		440	6.0
13	2	0	5.2	END CUTTING 12:58	535	6.0
13	8	0	1.5		443	6.0
13	14	0	0.6		150	6.0
13	20	0	2.3		273	6.0
13	26	0	1.5	TAP 13:22-13:26	538	6.0
13	32	0	0.2	CHARGE 1 13:29-13:30	180	6.0
13	38	0	0.8		300	0.8
13	44	0	1.9		---	---
13	50	0	3.1		---	---
13	56	0	4.6		---	---
14	2	0	0.0		---	---
14	8	0	2.5		---	---
14	14	0	1.0	CHARGE 3 14:13	---	---
14	20	0	1.7		48	3.3
14	26	0	4.4	END CUTTING 14:25	246	6.0
14	32	0	3.1		260	6.0
14	38	0	4.0		215	6.0
14	44	0	6.9		250	6.0
14	50	15	4.4		350	6.0
14	56	15	7.9	TAP 14:54-14:58	370	6.0
15	2	15	0.8	TAP 14:54-14:58	190	6.0
15	8	15	0.0	CHARGE 1 15:03	185	6.0
15	14	15	0.0		20	6.0
15	20	15	0.0		23	4.0
15	26	15	0.0		120	6.0
15	32	15	2.1	CHARGE 2 15:29-15:30	100	6.0
15	38	15	0.0		5	6.0
15	44	15	0.0		40	6.0

ESP OUTLET SUMMARY STATISTICS

NUMBER OF AVG'S	MAX AVG	MEAN	STANDARD DEVIATION
71	7.9	1.1	1.74

TABLE 5-9 TOKYO STEEL VE DATA

NOVEMBER 8 . 1982

OBSERVER GROUP-COY/KLOTZ/COY

			ESP OUTLET		ESP INLET	
HR	TIME MIN	SEC	CONSECUTIVE SIX-MINUTE AVG OPACITY-%	FURNACE OPERATIONS	INLET INDEX OPAC-MIN	MINUTES OF DATA ON WHICH INLET IS BASED
8	22	45	0.0		48	5.0
8	28	45	1.9		150	6.0
8	36	45	3.5	CHARGE 3 8:29	200	6.0
8	42	45	7.3		440	6.0
8	48	45	1.3	END CUTTING 8:43	130	6.0
8	54	45	0.2		60	6.0
9	0	45	0.0		35	6.0
9	6	45	0.0		30	6.0
9	12	45	0.0		30	6.0
9	18	45	2.7	TAP 9:18-9:22	255	6.0
9	25	15	1.7	TAP 9:18-9:22	505	6.0
9	31	15	1.3	CHARGE 1 9:26	340	6.0
9	37	15	0.0		23	6.0
9	43	15	1.0		30	6.0
9	49	15	4.8		453	6.0
9	57	0	7.9	CHARGE 2 9:50-9:52	425	6.0
10	3	0	0.0		18	6.0
10	9	0	0.8	CHARGE 3 10:09-10:11	120	6.0
10	15	0	4.6	CHARGE 3 10:09-10:11	395	6.0
10	21	0	0.6		313	6.0
10	27	0	4.0	END CUTTING 10:24	548	6.0
10	33	0	3.3		373	6.0
10	39	15	2.1		250	6.0
10	45	15	0.0		135	6.0
10	51	15	3.8		415	6.0
10	58	0	3.1	TAP 10:54-10:56	415	6.0
11	4	0	0.0	CHARGE 1 11:00-11:02	229	6.0
11	10	0	0.0		30	6.0
11	16	0	0.0		30	6.0
11	22	0	0.4		40	6.0
11	29	30	7.1	CHARGE 2 11:27-11:28	239	6.0
11	35	30	0.2		83	6.0
11	41	30	0.0		85	6.0
11	47	30	2.1	CHARGE 3 11:46-11:47	283	6.0
11	53	30	1.9		320	6.0
11	59	30	5.4	END CUTTING 11:59	380	6.0
12	5	30	1.5		244	6.0
12	11	30	0.6		81	6.0

TABLE 5-9 (continued)

12	17	30	0.2		18	6.0
12	23	30	1.0		291	6.0
12	31	30	1.9	TAP 12:24-12:26	279	4.0
12	37	45	0.4		---	---
12	43	45	0.0		---	---
12	49	45	1.5		---	---
12	56	45	4.8		---	---
13	3	30	3.5		---	---
13	9	30	1.0		---	---
13	15	30	4.8	CHARGE 3 13:14-13:16	540	1.8
13	21	30	2.1		103	6.0
13	27	30	6.0		218	6.0
13	33	30	1.3	END CUTTING 13:28	33	6.0
13	39	30	0.2		0	6.0
13	45	30	0.0		0	6.0
13	51	30	0.0		0	6.0
13	57	30	0.2		0	6.0
14	3	30	2.3	TAP 13:59-14:04	188	6.0
14	10	15	0.6	CHARGE 1 14:10-14:18	279	4.0
14	16	15	0.2	CHARGE 1 14:10-14:18	600	5.5
14	22	15	0.2	CHARGE 1 14:10-14:18	0	4.5
14	28	15	0.0		0	6.0
14	34	15	0.0		0	6.0
14	41	45	4.8		40	6.0
14	51	45	3.8	CHARGE 2 14:43-14:45	139	6.0
14	57	45	0.0		0	6.0
15	3	45	5.2	CHARGE 3 15:02-15:03	330	4.0
15	9	45	4.2		150	6.0
15	15	45	2.5		160	6.0
15	21	45	1.5	END CUTTING 15:18	180	6.0
15	27	45	4.6		100	6.0
15	33	45	1.5		220	6.0
15	39	45	4.6		370	6.0
15	45	45	2.9	TAP 15:43-15:46	230	6.0
15	51	45	1.3	CHARGE 1 15:51-15:52	30	4.0
15	57	45	0.4		0	4.0
16	3	45	0.0		0	6.0
16	9	45	0.8		20	6.0

ESP OUTLET SUMMARY STATISTICS

NUMBER OF AVG'S	MAX AVG	MEAN	STANDARD DEVIATION
76	7.9	1.9	2.06

TABLE 5-10 TOKYO STEEL VE DATA

NOVEMBER 8 . 1982

OBSERVER GROUP-BRANSCOME/GOLDMAN/BRANSCOME

TIME HR	TIME MIN	TIME SEC	ESP OUTLET CONSECUTIVE SIX-MINUTE AVG OPACITY-%	FURNACE OPERATIONS	ESP INLET INLET INDEX OPAC-MIN	ESP INLET MINUTES OF DATA ON WHICH INLET IS BASED
8	22	45	0.2		48	5.0
8	28	45	2.1		150	6.0
8	36	45	3.5	CHARGE 3 8:29	200	6.0
8	42	45	6.5		440	6.0
8	48	45	0.8	END CUTTING 8:43	130	6.0
8	54	45	1.0		60	6.0
9	0	45	0.0		35	6.0
9	6	45	0.4		30	6.0
9	12	45	0.0		30	6.0
9	18	45	3.1	TAP 9:18-9:22	255	6.0
9	24	45	0.4	TAP 9:18-9:22	530	6.0
9	30	45	0.2	CHARGE 1 9:26	360	6.0
9	36	45	0.0		25	6.0
9	42	45	0.2		30	6.0
9	48	45	3.5		405	6.0
9	56	0	9.8	CHARGE 2 9:50-9:52	528	6.0
10	2	0	0.0		28	6.0
10	8	0	0.4		40	6.0
10	14	0	6.5	CHARGE 3 10:09-10:11	375	6.0
10	20	0	0.8		383	6.0
10	26	0	3.8	END CUTTING 10:24	478	6.0
10	32	0	3.1		443	6.0
10	38	0	1.0		275	6.0
10	44	0	0.0		98	6.0
10	50	0	2.9		353	6.0
10	56	0	3.5	TAP 10:54-10:56	560	6.0
11	2	0	0.2	CHARGE 1 11:00-11:02	239	6.0
11	8	0	0.0		30	6.0
11	14	0	0.0		30	6.0
11	20	0	0.0		31	6.0
11	26	15	3.1		150	6.0
11	32	45	5.4	CHARGE 2 11:27-11:28	185	6.0
11	38	45	0.0		55	6.0
11	44	45	1.3		115	6.0
11	50	45	4.0	CHARGE 3 11:46-11:47	420	6.0
11	56	45	2.1		250	6.0
12	2	45	6.9	END CUTTING 11:59	485	6.0

TABLE 5-10 (continued)

12	8	45	0.0		75	6.0
12	14	45	0.6		20	6.0
12	20	45	0.4		200	6.0
12	26	45	0.2	TAP 12:24-12:26	220	6.0
12	34	15	0.6		600	1.0
12	40	15	0.0		---	---
12	46	15	0.2		---	---
12	52	15	2.5		---	---
13	0	0	5.8		---	---
13	6	0	0.8		---	---
13	12	0	1.0		---	---
13	18	0	6.3	CHARGE 3 13:14-13:16	342	4.3
13	24	0	1.0		60	6.0
13	30	0	6.3	END CUTTING 13:28	208	6.0
13	36	0	0.0		0	6.0
13	42	0	0.2		0	6.0
13	48	0	0.0		0	6.0
13	54	0	0.0		0	6.0
14	0	0	0.6	TAP 13:59-14:04	13	6.0
14	7	30	2.1	TAP 13:59-14:04	268	4.3
14	13	30	0.0	CHARGE 1 14:10-14:18	475	5.8
14	19	30	0.2	CHARGE 1 14:10-14:18	338	4.0
14	25	30	0.0		0	6.0
14	31	30	0.0		0	6.0
14	37	30	0.6		0	6.0
14	44	0	10.4	CHARGE 2 14:43-14:45	295	6.0
14	53	0	0.8		38	6.0
14	59	0	0.4		13	6.0
15	5	15	6.5	CHARGE 3 15:02-15:03	319	4.0
15	11	15	4.2		135	6.0
15	17	15	2.7		220	6.0
15	23	15	1.3	END CUTTING 15:18	120	6.0
15	29	15	3.1		160	6.0
15	35	15	2.1		273	6.0
15	41	15	4.4		333	6.0
15	47	15	2.7	TAP 15:43-15:46	187	4.5
15	53	15	0.4	CHARGE 1 15:51-15:52	30	4.0
15	59	15	0.0		0	5.5
16	5	15	0.0		15	6.0

ESP OUTLET SUMMARY STATISTICS

NUMBER OF AVG'S	MAX AVG	MEAN	STANDARD DEVIATION
76	10.4	1.9	2.43

TABLE 5-11 TOKYO STEEL VE DATA

NOVEMBER 9 . 1982

OBSERVER GROUP-KLOTZ/COY/KLOTZ

			ESP OUTLET		ESP INLET	
HR	TIME MIN	SEC	CONSECUTIVE SIX-MINUTE AVG OPACITY-%	FURNACE OPERATIONS	INLET INDEX OPAC-MIN	MINUTES OF DATA ON WHICH INLET IS BASED
8	26	0	0.0		220	5.3
8	32	0	1.5		180	6.0
8	38	0	1.5	TAP 8:35-8:39	433	6.0
8	44	0	0.0	CHARGE 1 8:43-8:44	420	6.0
8	50	0	0.0		148	6.0
8	56	0	0.0		44	6.0
9	2	0	0.0		41	6.0
9	8	0	1.3	CHARGE 2 9:05-9:07	523	6.0
9	14	0	0.4		205	6.0
9	20	0	0.0		41	6.0
9	26	0	1.0	CHARGE 3 9:25-9:27	369	6.0
9	32	45	0.8		520	6.0
9	38	45	2.9		600	6.0
9	44	45	6.5	END CUTTING 9:43	600	6.0
9	50	45	2.3		600	2.0
9	56	45	2.3		330	4.0
10	2	45	2.1		460	6.0
10	8	45	5.0		560	6.0
10	14	45	4.0	TAP 10:14-10:18	400	6.0
10	20	45	0.8	TAP 10:14-10:18	420	6.0
10	26	45	0.0	CHARGE 1 10:23-10:25	440	6.0
10	32	45	0.0		20	6.0
10	38	45	0.0		10	6.0
10	44	45	0.8		30	6.0
10	50	45	4.2	CHARGE 2 10:46-10:48	440	6.0
10	56	45	0.0		90	6.0
11	2	45	0.2		80	6.0
11	8	45	4.8	CHARGE 3 11:06	180	6.0
11	14	45	2.1		280	6.0
11	20	45	1.7	END CUTTING 11:18	360	6.0
11	26	45	0.2		190	6.0
11	32	45	0.0		20	6.0
11	38	45	2.1		70	6.0
11	44	45	3.5		220	6.0
11	50	45	2.5	TAP 11:47-11:51	380	6.0
11	56	45	0.2	CHARGE 1 11:55-11:57	280	6.0
12	2	45	0.0		0	2.0

TABLE 5-11 (continued)

12	8	45	0.0		---	---
12	14	45	1.7		---	---
12	20	45	5.4		---	---
12	26	45	0.0		---	---
12	32	45	0.4		---	---
12	38	45	2.7		---	---
12	44	45	0.6		---	---
12	50	45	2.9		---	---
12	56	45	3.1		---	---
13	2	45	0.4		---	---
13	8	45	0.0		---	---
13	14	45	0.0		---	---
13	20	45	1.0	TAP 13:19-13:21	300	2.0
13	27	30	2.5	CHARGE 1 13:27-13:28	175	6.0
13	33	30	0.0		50	6.0
13	39	30	0.0		0	6.0
13	45	30	1.7		43	6.0
13	55	0	2.1	CHARGE 2 13:48-13:49	73	6.0
14	1	0	0.0		20	6.0
14	7	0	1.0		25	6.0
14	14	0	7.7	CHARGE 3 14:09	268	6.0
14	20	0	14.4		283	6.0
14	26	0	16.0	END CUTTING 14:23	343	6.0
14	33	30	3.3		138	6.0
14	39	30	0.0		15	6.0
14	45	30	1.3		53	6.0
14	51	30	4.6		165	6.0
14	59	30	5.6	TAP 14:53-14:57	313	6.0
15	6	15	0.2	CHARGE 1 15:01	33	4.5
15	12	15	0.0		0	3.5
15	18	15	0.0		30	6.0
15	24	15	0.6		25	6.0
15	31	0	6.3	CHARGE 2 15:27-15:29	448	6.0
15	37	0	0.2		78	6.0
15	43	0	0.4		65	6.0
15	49	0	4.2	CHARGE 3 15:44-15:45	318	6.0
15	55	0	2.7		193	6.0
16	1	0	6.7		415	6.0
16	7	0	2.1	END CUTTING 16:03	303	6.0

ESP OUTLET SUMMARY STATISTICS

NUMBER OF AVG'S	MAX AVG	MEAN	STANDARD DEVIATION
76	16.0	2.1	2.92

TABLE 5-12 TOKYO STEEL VE DATA

NOVEMBER 9 . 1982

OBSERVER GROUP-GOLDMAN/COY/GOLDMAN

			ESP OUTLET			ESP INLET
HR	TIME MIN	SEC	CONSECUTIVE SIX-MINUTE AVG OPACITY-%	FURNACE OPERATIONS	INLET INDEX OPAC-MIN	MINUTES OF DATA ON WHICH INLET IS BASED
8	26	30	0.0		206	5.8
8	32	30	1.9		180	6.0
8	38	30	1.5	TAP 8:35-8:39	478	6.0
8	44	30	0.0	CHARGE 1 8:43-8:44	420	6.0
8	50	30	0.0		103	6.0
8	56	30	0.0		41	6.0
9	2	30	0.2		54	6.0
9	8	45	1.9	CHARGE 2 9:05-9:07	548	6.0
9	14	45	0.2		160	6.0
9	20	45	0.0		30	6.0
9	26	45	3.3	CHARGE 3 9:25-9:27	440	6.0
9	33	0	1.3		520	6.0
9	39	0	3.5		600	6.0
9	45	0	5.0	END CUTTING 9:43	600	6.0
9	51	0	1.5		600	1.8
9	57	0	2.5		346	4.3
10	3	0	2.1		460	6.0
10	9	0	4.6		535	6.0
10	15	0	4.6	TAP 10:14-10:18	420	6.0
10	21	0	0.0	TAP 10:14-10:18	405	6.0
10	27	0	0.2	CHARGE 1 10:23-10:25	436	6.0
10	33	0	0.0		20	6.0
10	39	0	0.0		9	6.0
10	45	0	1.0		55	6.0
10	51	0	4.2	CHARGE 2 10:46-10:48	423	6.0
10	57	0	0.0		84	6.0
11	3	0	0.0		81	6.0
11	9	0	4.6	CHARGE 3 11:06	180	6.0
11	15	0	1.3		288	6.0
11	21	0	1.9	END CUTTING 11:18	370	6.0
11	27	0	0.4		171	6.0
11	33	0	0.0		20	6.0
11	39	0	2.3		74	6.0
11	45	0	3.3		235	6.0
11	51	0	1.3	TAP 11:47-11:51	368	6.0
11	57	0	0.0	CHARGE 1 11:55-11:57	273	6.0
12	3	0	0.0		0	1.8

TABLE 5-12 (continued)

12	9	0	0.0			
12	15	0	2.5		---	---
12	21	0	4.8		---	---
12	27	0	0.0		---	---
12	33	0	0.6		---	---
12	39	0	3.1		---	---
12	45	0	0.2		---	---
12	51	0	2.3		---	---
12	57	0	2.3		---	---
13	3	0	0.0		---	---
13	9	0	0.0		---	---
13	15	0	0.0		---	---
13	21	15	0.8		---	---
13	27	15	2.9	TAP 13:19-13:21	300	2.5
13	33	15	0.0	CHARGE 1 13:27-13:28	155	6.0
13	39	15	0.0		60	6.0
13	45	15	1.5		0	6.0
13	55	30	1.3		35	6.0
14	1	30	0.2	CHARGE 2 13:48-13:49	58	6.0
14	7	45	1.5		20	6.0
14	14	45	7.7		40	6.0
14	20	45	16.0	CHARGE 3 14:09	275	6.0
14	26	45	13.1		320	6.0
14	34	15	2.3	END CUTTING 14:23	320	6.0
14	40	15	0.2		100	6.0
14	46	15	2.3		30	6.0
14	53	0	5.2		45	6.0
15	0	15	5.0	TAP 14:53-14:57	210	6.0
15	6	45	0.6	TAP 14:53-14:57	260	6.0
15	12	45	0.0	CHARGE 1 15:01	30	4.0
15	18	45	0.0		0	4.0
15	25	0	1.9		40	6.0
15	31	45	5.8		45	6.0
15	37	45	0.0	CHARGE 2 15:27-15:29	191	6.0
15	43	45	0.6		30	6.0
15	49	45	3.5		80	6.0
15	55	45	4.6	CHARGE 3 15:44-15:45	310	6.0
16	1	45	5.8		230	6.0
16	7	45	1.7		400	6.0
				END CUTTING 16:03	310	6.0

ESP OUTLET SUMMARY STATISTICS

NUMBER OF AVG'S	MAX AVG	MEAN	STANDARD DEVIATION
76	16.0	2.0	2.80

the baghouse offtake, in anticipation of tapping. The operator apparently expected a favorable steel sample analysis that did not occur. A similar explanation may apply to November 6, but is not known to be true. Retraction of the connecting duct while the electrodes are receiving power produces a significant dust load for the REP, appearing at least as heavy as that for backcharging. Since the REP is more sensitive to sudden changes in inlet concentration than a baghouse, operator training and skill is a significant factor in maintaining low REP emissions. Earlier discussion in this section emphasized operator skill in relation to controlling emissions during scrap cutting.

The design furnace capacity at the time of the REP design was 70 tonne per cycle. The increase in furnace capacity to 100 tonne per cycle probably contributes to the occurrence of higher VE opacity. Specifically, the extensive scrap cutting period following the third scrap charge is likely necessitated by the effort to achieve the higher capacity. The duration of scrap cutting (average of 14 minutes during these tests) produces a long period of often heavy furnace discharges as compared to charging periods (typically 1 to 2 minutes). Also, the practice of scrap preheating, begun subsequent to initial design, leads to fugitive smoke emissions from hot scrap as the charging bucket traverses and waits in the charging aisle. Given these conditions at the time of REP design, the design could be adjusted to provide additional collection surface and gas flow capacity. Alternatively, the scrap cutting problem might be solved by design changes to the connecting section of duct between the direct shell evacuation offtake and baghouse offtake.

This test program did not include measurement of dust concentrations. Particulate concentration measurements were reported in Section 5.2. The 1975 tests compared favorably to the present NSPS for EAF particulate collection devices, 12 mg/dscm. The 1982 test results were higher, 18 mg/scm (about equal to 18 mg/dscm). The increase was partially attributed to increased dust resistivity by Sumitomo Metal Mining. The difference in particulate test methodology between Japan and the United States makes a clear statement that the REP has demonstrated the capability to meet the NSPS particulate device concentration not possible. However, it can be stated that the measurements suggest the REP can attain the NSPS level with proper design.

At this time EPA has made no policy statement on the status of REP's applied to EAF plants. The question is whether an REP would be considered an extension of the EAF building roof or roof monitor, or a particulate control device. In the former case the REP would be subject only to roof monitor visible emissions limits. In the latter case, it would be subject to the current NSPS particulate device concentration limit of 12 mg/dscm and 3% opacity. It is also reasonable to consider that neither category strictly applies and that a special category of rules should be applied to REP's. Consideration of these questions is appropriate to avoid discouraging industry interest in what appears to be innovative, energy saving technology.

6.0 COMPUTER MODELING OF ROOF-MOUNTED ELECTROSTATIC PRECIPITATOR

A study was undertaken to determine the applicability of the EPA/Southern Research Institute computer model of electrostatic precipitation to the roof-mounted ESP. This effort had two phases -- phase I to determine if the computer model fit the data from the roof mounted ESP and phase II to determine if roof-mounted ESPs could provide control for other sources in the iron and steel industry. Phase II would only be undertaken if phase I were successful.

The criteria for success in phase I were: 1) electrical conditions agreed with general electrical conditions for the plate spacing and resistivity in the roof-mounted ESP; 2) predicted penetration agreed with measured penetration for usual values of non-ideal factors; 3) predicted opacity agreed with the measured opacity.

6.1 MODEL DESCRIPTION

The ESP model predicts ESP performance in a two-step process. First an ideal collection efficiency is calculated. This ideal efficiency is then adjusted by empirical and semi-empirical factors to account for various non-ideal and un-modeled effects. The data base for these correction factors is basically data collected on ESPs operating on coal-fired boilers.

The ideal collection efficiency is calculated based on the Deutsch-Anderson (D-A) model. Several important assumptions are made in the D-A model. The computer model must be constructed in such a way as to insure the one most often neglected by those building ESP models) is that the particles all have the same constant migration velocity. This assumption requires constant electrical conditions and monodisperse particles. Since neither condition exists in industrial ESPs -- the electrical conditions vary and the particles are not monodisperse blind application of the D-A model is impossible.

The EPA/SoRI model satisifies the assumptions of the D-A model by first dividing the ESP into a number of small increments in the direction of gas flow. This allows the model to treat a non-ideal ESP as a series of ideal ESPs. The electrical conditions within each increment are constant, however, electrical conditions in adjacent increments do not have to be constant. The electrical conditions in each increment are calculated by rigorous solution of the field equations for wire-plate ESPs. This solution includes the effect of both ionic and particulate space charge.

The effects of particle size distribution are incorporated by doing all calculations for single-sized particles and then integrating the individual results over the particle size distribution. The number of particle diameters and the values of the particle diameters to use in the calculation depends on the particular situation.

6.2 INPUT DATA

The input data required to run the model are ESP design information (plate-plate spacing, wire-wire spacing, total plate area), ESP electrical operating data (voltage and current), particle size distribution, particulate mass loading, gas temperature, and gas flow rate. The electrica resistivity of the particulate matter, while not essential when actual electrical operating data are available, is useful. The input data are summarized in Table 6-1.

Many of the input data showed considerable variability. For example, the operating voltage varied from about 54 to 68 kV. And the mass loading varied from 0.15 to 0.5 g/scm with even higher spikes. Normal operation for the modeling was assumed to be 62kV and 0.15 g/scm.

The particle size distribution also varied. The particle size distribution from three hoppers was -- front mass mean diameter = 11 micrometer, geometric standard deviation = 8; center mass mean diameter = 4.5 micrometers, geometric standard deviation = 7; and rear mass mean diameter = 2.5 micrometers, geometric standard deviation = 4. For the modeling study, the middle hopper size distribution was assumed to be typical. The size distribution from the front hooper is referred to as coarse and the size distribution from the rear hopper is referred to as fine for the rest of this paper.

The effects of the variability in the input data are discussed later in this paper.

TABLE 6-1. Typical Input Data for ESP Model

Dust Characteristics

Dust loading - 0.15 g/scm (0.07 gr/scf)
Particule density - 2200 kg/m^3
Mass mean diameter - 4.5 micrometers
Geometric standard deviation 7

Precipitator Characteristics

Plate area - 1750 m^2 (18,890 square feet)
Plate length - 8.8 m (29 feet)
Wire to plate spacing - 200 mm (7.87 in)
Wire to wire spacing - 250 mm (9.84 in)
Normal rapping emissions

Gas Flow Characteristics

Gas volume flow rate - 2800 m^3/min (9.876 x 10^4 acfm)
Gas velocity 1 m/s (3.2 ft/s)
Non-ideal factors standard cold side (Sneakage 0.05, gas velocity std. deviation 0.20)

6.3 MODELING RESULTS

The reported electrical operating conditions were in good agreement with the electrical operating conditions predicted by DuBard and Altman[10] for the resistivity and plate to plate spacing. The fact that the correlation for electrical operating conditions gave reasonable answers, gives confidence that the correlations can be used to estimate electrical operating conditions for other sources in the iron and steel industry.

The particulate collection efficiency results for the various inlet data are shown in Table 6-2. Note that the predicted and measured data are in good agreement. Also note that the predicted opacity is in good agreement with the measured opacity.

TABLE 6-2. Summary of Calculated Results for Roof-Mounted ESP

Electrical Conditions	Inlet Loading g/scm	Size Distribution	Efficiency %	Opacity %
Normal	0.5	Normal	87.06	7.1
Normal	0.15	Normal	87.06	1.2
Normal	0.5	Fine	86.11	7.8
Normal	0.15	Fine	86.15	1.8
Normal	0.5	Coarse	88.24	3.8
Normal	0.15	Coarse	88.24	1.2
Excellent	0.15	Normal	89.24	0.9
Poor	0.15	Normal	85.55	2.4
Poor	1.0	Normal	85.55	14.0

Measured opacities ranged from 0 to 16% with 99% of the observations less than 20% and 50% of the observatios less than 1%. Measured efficiency ranged from 88 to 96% depending on assumed inlet loading. Measured inlet loading ranged from 0.15 to over 1 g/scm.

The uncertainty in the inlet mass loading is the major source of uncertainty in the calculated results. The inlet loading is reported to vary from 0.15 to 0.5 g/scm with peaks exceeding 1.0 g/scm. The effect of these variations in inlet loading is most obvious in the calculated and observed opacity.

Even with this, it appears that the model predicts opacities that are good agreement with the measured values.

Modeling over the entire range of actual electrical operating conditions gave opacity results that covered the range of reported opacities. Limited analysis of the percent of the time that a given operating condition existed, showed that the same basic histogram for calculated opacity could be obtained as was obtained for the measured opacity.

6.4 EXTENSION TO OTHER SOURCES

Now that the model has been established as reasonable, it can be used to estimate potential use of roof-mounted ESPs for other sources in the iron and steel industry. In order to provide information on dust properties, samples from a BOF shop and a blast furnace casthouse were obtained. The laboratory resistivity of these dusts under conditions likely in a roof-mounted ESP (159°F and low humidity) was in the high 10^{11} ohm-cm range. This is not much different from that of the Tokyo Steel samples.

The correlations of DuBard and Altman[10] were used to estimate the electrical operating conditions for the roof-mounted ESP for the two dusts. The inlet particle size distribution was assumed to be mass mean diameter = 4, and geometric standard deviation = 7. The design of the roof-mounted ESP was assumed to be the same as the Tokyo Steel unit. The results of this modeling show that the performance should be very similar to that observed at the Tokyo steel plant. The results are given in Table 6-3.

The results discussed in Table 6-3 show that the ESP computer model can usefully be used to investigate ESPs applied to industries other than coal-fired boilers. The model study suggests that an REP can be equally effectively applied to BOF fugitive emissions and blast furnace casthouse fugitive emissions. Additional tests of the model for various sources in the iron and steel industry are necessary to provide the same level of confidence in the model as exists in the utility industry. Such tests should include measurement of in-situ electrical resistivity and simultaneous measurement of inlet and outlet particulate size distribution and mass loading.

TABLE 6-3. Results of Modeling Other Sources

Source	Assumed Resistivity ohm-cm	Voltage kV	Current Density nA/cm^2	Efficiency %	Opacity %
BF casthouse	4×10^{11}	63	4.4	87	2.4
BOF	4×10^{11}	63	4.4	87	2.4
BF casthouse	2×10^{12}	57	2	84.8	10
BOF	2×10^{12}	57	2	84.8	10

Calculations assume a mass mean particle diameter of 4 micrometers and geometric standard deviation of 7. The ESP is assumed to be a single section with a SCA of 37.7 m^2/m^3. The inlet concentration is assumed to be 0.2 g/m^3.

7.0 REFERENCES

[1] C.O. Bennett and J.E. Meyers, Momentum, Heat, and Mass Transfer, McGraw-Hill. New York, 1962, p. 24.

[2] J.A. Danielson, Air Pollution Engineering Manual, U.S. Department of Health, Education, and Welfare, Cincinnati, Ohio, 1967, p. 25.

[3] O.G. Sutton, J. Meteorology, 7, October, 1950, pp. 307-312.

[4] W.C.L. Hemeon, Plant and Process Ventilation, Industrial Press, New York, 1963, pp. 160-196.

[5] Hemeon, *Ibid*., p. 170.

[6] K.E. Caine, "Development of Technology for Controlling BOP Charging Emissions," EPA Report 600/2-77-218, October 1977, p. 61.

[7] Danielson, *op*. *cit*., p. 35, there is an error in Danielson. Danielson gives an exponent of 1.38 instead of 1.14; 1.14 is correct.

[8] Hemeon, *op*. *cit*., p. 178.

[9] Caine, *op*. *cit*., p. 52.

[10] Caine, *op*. *cit*., p. 5.

[11] Caine, *op*. *cit*., p. 53.

[12] H.E. McGannon, ed., "The Making, Shaping, and Treating of Steel," Herbich & Held, Pittsburgh, 1979, pp. 297-298.

[13] U.S. Environmental Protection Agency, "Revised Standards for Basic Oxygen Process Furnaces--Background Information for Proposed Standards," November 1980, pp. 3-28.

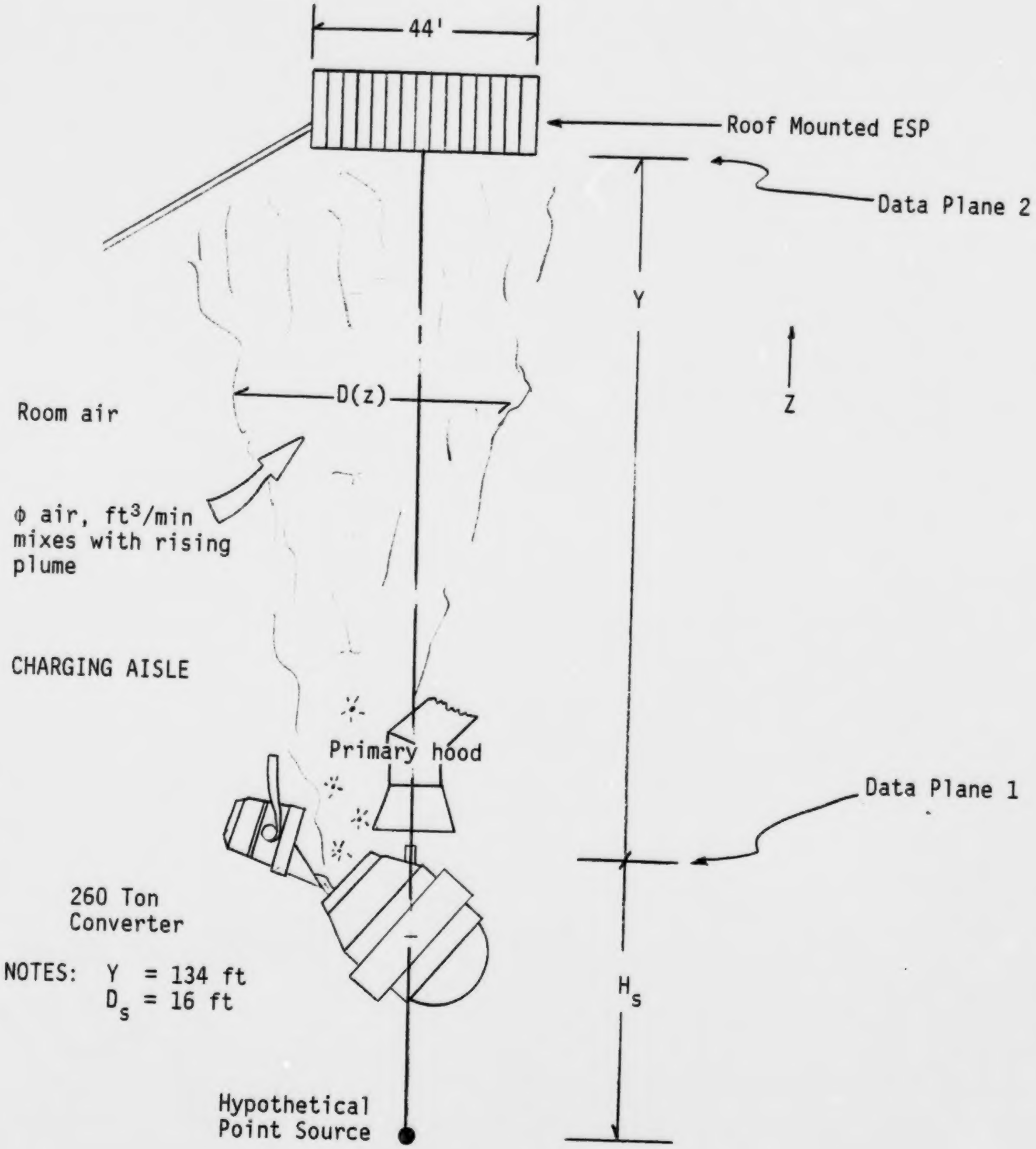
[14] U.S. Environmental Protection Agency, *Ibid*., pp. 3-12.

[15] Perry's, p. 12-4, based on estimate of in-plant conditions.

[16] Design conditions for Sumitomo ESPs is 140° F inlet temperature.

APPENDIX A

CALCULATION OF THE PLUME CHARACTERISTICS FROM A CONVERTER AND THE APPLICABILITY OF A ROOF-MOUNTED ESP



44'
Roof Mounted ESP
Data Plane 2
Y
Z
D(z)
Room air
ϕ air, ft³/min mixes with rising plume
CHARGING AISLE
Primary hood
Data Plane 1
260 Ton Converter
NOTES: Y = 134 ft
D_s = 16 ft
H_s
Hypothetical Point Source

FIGURE 1.

Problem: Calculate the velocity, volumetric flow rate, and temperature profile of the plume shown in Figure 1.

The applicable macroscopic energy balance for this system is given by[1]:

$$\frac{1}{2gc}\left[w_2 v_2^2 - w_1 v_1^2\right] + \frac{g}{gc}\left[w_2 z_2 - w_1 z_1\right] + \left[w_2 H_2 - w_1 H_1\right] = \phi_{air}\, \rho_{air}\, H_{air}$$

This balance is derivable assuming a plug flow velocity profile across the diameter of the plume, constant ambient air conditions, and no energy accumulation with time.

The applicable material balance is:

$$\phi_2 \rho_2 - \phi_1 \rho_1 = \phi_{air}\, \rho_{air}$$

Danielson[2] states that since pressure changes are small and all air flow originates from a "reservoir" of constant energy (the atmosphere) the energy balance may be applied to the bulk flow of the plume as a whole.

As hot air rises from the mouth of the convertor, its velocity is initially high and then decreases as it is mixed with room air and its temperature decreases. Sutton[3] and Hemeon[4] have developed empirical relationahips for the velocity and dimensions of a hot rising plume as a function of system parameters:

$$D_p = \frac{z^{.88}}{2}$$

D_p = Dia. of plume, ft.

z = height, ft. (Fig. 1)

$$V(z) = \frac{37}{z^{.29}} (Q)^{1/3}$$

V = velocity of plume, ft/min

Q = heat loss from source, BTU/min

Q, the heat transfer rate from the hot source in BTU/min, can be calculated knowing the convective heat transfer coefficient, h_c, the source temperature, T_s, and the ambient temperature, T_a:

$Q = h\ A_s\ (T_s - T_a)$ $\qquad A_s$ = area of hot source, ft²

The heat transfer coefficient for natural convection is a function of $(T_s - T_a)^5$;

$h = .38\ (T_s - T_a)^{1/4}$ $\qquad T_s$ = temp. of source, °F

T_a = ambient temp., °F

For the converter in question $T_s \approx 2600°F$, $T_a \approx 80°F$ and

$$h \cong 2.7\ \text{BTU/hr-ft}^2\text{-°F}$$

Thus, for a 16' diameter converter mouth (not accounting for the angle of tilt, which is ~25° [6])

$A_s = \frac{\pi D_s^2}{4} = 201\ \text{ft}^2$ $\qquad D_s$ = dia. of hot source, ft.

and

$$Q = h\ A_s\ (T_s - T_a)$$

$$= 1.37 \times 10^6\ \frac{\text{BTU}}{\text{hr}}$$

and

$$V(z) = \frac{37}{z^{.29}} \left(\frac{1.37 \times 10^6}{60}\right)^{1/3} = \frac{1050}{z^{.29}}$$

From Danielson[7] and Figure 1

$H_s = (2\ d_s)^{1.14}$ $\qquad D_s$ = 16 ft.

$$= 52\ \text{ft.}$$

(Hemeon neglects the 1.14 exponent)[8]

For the structure in question (Figure 1), when

$$Z = Y + H_s = 186 \text{ ft}$$

then $$D_p = 50 \text{ ft}$$

or about the diameter of the roof mounted ESP. The velocity of the plume is:

$V_1 = 334$ ft/min (5.6 ft/sec)	at the mouth of the vessel, or $Z = H_s = 52$
$V_2 = 231$ ft/min (3.8 ft/sec)	at the roof, or $Z = 186$ ft

The volumetric flow rate, ϕ_2, of charging emissions at the roof is

$$\phi_2 = (V_2)\left(\frac{\pi D_p^2}{4}\right)_{186}$$

$$= \left(231 \frac{\text{ft}}{\text{min}}\right)(1964 \text{ ft}^2)$$

$$= 4.54 \times 10^5 \frac{\text{ft}^3}{\text{min}}$$

Carne[9] gives an "average" emission velocity of 2950 ft/min (49 ft/sec) with an observed range of 1000-5200 ft/min and an average volumetric flow rate of 5.2 x 10^5 ft^3/min with a range at 1.7 - 9.3 x 10^5 ft^3/min. A value of 1100 to 2600 ft^3/min-tonne is also reported.[10] Using this latter data, for a 260 tonne converter, emissions should be between 2.86 x 10^5 ft^3/min and 6.76 x 10^5 ft^3/min.

Thus, while Carne's values for velocity seem high (49 ft/sec versus a maximum of 5.6 ft/sec calculated for the system), the volumetric flow rate closely approximates his average value, 4.54 x 10^5 ft^3/min versus his "average" of 5.2 x 10^5 ft^3/min.

Now, D. W. Coy of RTI has observed an approximate 9 ft/sec average velocity in the charging process. Since natural convection from the mouth of this particular converter results in only a 5.6 ft/sec maximum velocity, a chemical reaction may be taking place to account for this additional energy.

The average (converter mouth to roof) velocity, $\bar{V}$, calculated from natural convection is

$$\bar{V} = \frac{\int_{52}^{186} V(z)dz}{\int_{52}^{186} dz} \qquad [\bar{V}] = \text{ft/min}$$

$$= \frac{1050}{134} \int_{52}^{186} \frac{dz}{z^{.29}}$$

$$= \frac{1050}{(134)(.71)} \quad (186)^{.71} - (52)^{.71}$$

$$= 269 \text{ ft/min } (4.5 \text{ ft/sec})$$

This is about half the observed value. Reactions that may take place during charging accounting for the higher observed velocity include vaporization/oxidation of "tramp" contaminants in the scrap and oxidation of carbon or iron particulates. Carne[11] observed an average particulate emission of 10.2 gm/m^3 which coupled with the average emission rate of 14,800 m^3/min results in 150 kg/min. Since Carne observed little oxidized carbon (CO or CO_2), any additional heat above natural convection would have to come from oxidation of iron or other materials present in the converter. Carne's analysis of the oxidized particulate showed[11]:

12.7%	FeO
8.3%	Fe_2O_3
3.5%	CaO
3.4%	ZnO
5.2%	SiO_2
2.2%	Al_2O_3

If it is assumed that only the oxidation of iron compounds occurs, i.e., that the remaining oxides are present in the charge or flux, then from McGannon[12] at about 2000°F (1093°C)

$$(1)\quad Fe_{(s)} + 1/2\ O_2 \rightarrow FeO_{(s)} \qquad \Delta F^\circ = -63{,}200 + 15.47\ (1093)$$

$$= -46.3\ \text{kcal/g-mole}$$

$$(2)\quad 2Fe_{(s)} + 3/2\ O_{2(s)} \rightarrow Fe_2\ O_3 \qquad \Delta F^\circ = -192{,}800 + 58.3\ (1093)$$

$$= -129.1\ \text{kcal/g-mole}$$

The total heat given off by these two reactions is:

$$(1)\quad (.127)\ (150 \times 10^3\ \frac{g}{min})\ (1\ \frac{\text{g-mole}}{72g})\ (46.3\ \frac{kcal}{\text{g-mole}})\ (3.97\ \frac{BTU}{kcal}) = 48{,}600\ \frac{BTU}{min}$$

$$(2)\quad .083\ (150 \times 10^3\ \frac{g}{min})\ (1\ \frac{\text{g-mole}}{160\ g})\ (129\ \frac{Kcal}{\text{g-mole}})\ (3.97\ \frac{BTU}{kcal}) = 39{,}900\ \frac{BTU}{min}$$

$$\text{TOTAL HEAT} = 88{,}500\ \frac{BTU}{min}$$

Since the natural convective loss was calculated to be 1.37×10^6 BTU/min and since the velocity goes up as the 1/3 power of heat loss, this additional heat from the oxidation reaction is insignificant. Including it in the calculation of velocity increases the velocity by only 2%. EPA[13] shows that oily scrap charges result in 16.7% FeO and 10.6% Fe_2O_3 with emissions of 38 lbs/100 tons steel.[14] Following the same calculation as before the result in only a 1% increase in velocity.

Thus, the observed 9ft/sec average velocity cannot be verified using these calculations. Perhaps additional reactions are occurring, or the geometry of the converter, with reactions occurring in the bottom of the vessel, give the escaping gas on initial velocity additive to that calculated from natural convection alone.

In any case, the material and energy balances below may be solved to find the two unknowns, ϕ_{air} and T_2. Knowing these two guantities, the total head at the roof can be calculated to determine if the rising plume has enough "driving force" to make it through the ESP.

Material Balance

$$\phi_2 \rho_2 - \phi_1 \rho_1 = \phi_{air} \rho_{air} \qquad [V_i \ A = \phi_i]$$

Energy Balance

$$\frac{1}{2g_c}[w_2 V_2^2 - w_1 V_1^2] + \frac{g}{gc}[w_2 Z_2 - w_1 Z_1] + [w_2 H_2 - w_1 H_1] = \phi_{air} \rho_{air} H_{air}$$

Now, defining the values in these equations (see also Figure 1):

$\phi_2 = 4.54 \times 10^5 \frac{ft^3}{min}$

$w_1 = \frac{\phi_1 \rho_1}{60} = (\frac{680}{60}) \frac{lb}{sec} = 11.33 \frac{lb.}{sec}$

$\rho_2 = \frac{PM}{RT_2} = \frac{39.7}{T_2}$

$V_1 = 334 \frac{ft}{min}$

$\phi_1 = 5.23 \times 10^4 \frac{ft^3}{min}$

$H_2 = \int_{T^*_{ref}}^{T_2} Cp\, dT \cong .245(T_2 - Tref)$

$\rho_1 = .0130 \frac{lb}{ft^3}$

$H_1 = \int_{T^*_{ref}}^{T_1} Cp\, dT \cong 697 \frac{BTU}{lb}$

$\phi_{air} = \phi_{air}$

$H_{air} = 31 \frac{BTU}{lb}^*$

$\rho_{air} = .0736 \frac{lb}{ft^3}$

*(at 80°F, 50% RH[15] relative to 0°F), Let $T_{ref} = 0°F = 460°R$

$w_2 = \phi_2 \rho_2$

$$V_2 = 231 \frac{\text{ft}}{\text{min}}$$

Solving the material and energy balances:

(1) $$\frac{3.004 \times 10^5}{T_2} \frac{\text{lb}}{\text{sec}} - 1.133 \times 1^1 \frac{\text{lb}}{\text{sec}} = 1.227 \times 10^{-3} \phi_{air} \frac{\text{lb}}{\text{sec}}$$

(2) $$\frac{(6.914 \times 10^4}{T_2} \frac{\text{lb}_f\text{-ft}}{\text{sec}} - 3.512 \times 10^2 \frac{\text{lb}_f\text{-ft})}{\text{sec}} + \frac{(5.587 \times 10^7}{T_2} \frac{\text{lb}_f\text{-ft})}{\text{sec}}$$

$$- 5.893 \times 10^2 \frac{\text{lb}_f\text{-ft})}{\text{sec}} + (7.360 \times 10^4 \frac{\text{BTU}}{\text{sec}} - \frac{3.385 \times 10^7}{T_2} \frac{\text{BTU}}{\text{sec}}$$

$$- 7.899 \times 10^3 \frac{\text{BTU})}{\text{sec}} = \phi_{air} (3.803 \times 10^{-2}) \frac{\text{BTU}}{\text{sec}}$$

Note: $(\text{lb}_f\text{-ft} \times .00128 = \text{BTU})$

(1) $$3.004 \times 10^5 - 1.133 \times 10^1 T_2 = 1.227 \times 10^{-3} \phi_{air} T_2$$

(2) $$\frac{(8.850 \times 10^1}{T_2} \frac{\text{BTU}}{\text{sec}} - 4.495 \times 10^{-1} \frac{\text{BTU})}{\text{sec}} + \frac{(7.151 \times 10^4}{T_2} \frac{\text{BTU}}{\text{sec}}$$

$$- 7.543 \times 10^{-1} \frac{\text{BTU})}{\text{sec}} + (7.360 \times 10^4 \frac{\text{BTU}}{\text{sec}} - \frac{3.385 \times 10^7}{T_2} \frac{\text{BTU}}{\text{sec}}$$

$$- 7.899 \times 10^{3} \frac{\text{BTU}}{\text{sec}}) = 3.803 \times 10^{-2} \phi_{air} \frac{\text{BTU}}{\text{sec}}$$

(1) $2.448 \times 10^{8} - 9.234 \times 10^{3} T_2 = \phi_{air} T_2$

(2) $(8.850 \times 10^{1} + 7.151 \times 10^{4} - 3.385 \times 10^{7}) \frac{1}{T_2} - (4.495 \times 10^{-1} +$

$7.543 \times 10^{-1})$

$$- 7.360 \times 10^{4} + 7.899 \times 10^{3}) = 3.803 \times 10^{-2} \phi_{air}$$

(1) $- \frac{3.378 \times 10^{7}}{T_2} + 6.570 \times 10^{4} = 3.803 \times 10^{-2} \phi_{air}$

(2) $-8.882 \times 10^{8} + 1.728 \times 10^{6} T_2 = \phi_{air} T_2$

Now, equate (1) and (2)

$$2.448 \times 10^{8} - 9.234 \times 10^{3} T_2 = -8.882 \times 10^{8} + 1.728 \times 10^{6} T_2$$

$$1.133 \times 10^9 = 1.729 \times 10^6 \, T_2$$

$$T_2 = 652 \text{ °R}$$

$$T_2 = 192 \text{ °F}$$

This value for T_2 appears to be reasonable.[16]

Now, from (1),

$$\phi_{air} = 3.77 \times 10^5 \, \frac{ft^3}{min}$$

If instead the room air is at 40°F and 50% RH, then

$$\rho_{air} = .07946 \, \frac{lb}{ft^3}$$

$$H_{air} = 13 \, \frac{BTU}{lb}$$

and following the same procedure

$$T_2 = 117 \text{ °F}$$

and $\phi_{air} = 4.15 \times 10^5 \ \frac{ft^3}{min}$

Now, the total pressure of the rising plume at the roof is the static head less the velocity head (as the velocity head increases, the static head decreases).

$$\frac{g}{g_c}(\rho_{air} - \rho_2)\Delta Z - \rho_2 \frac{V_2^2}{2g_c} = P_{tot} \qquad \text{since } \rho_{air} > \rho_2$$

For 80°F, 50% relative humidity air,

$$P_{tot} = \underset{\substack{\uparrow \\ \text{static} \\ \text{head}}}{.327} - \underset{\substack{\uparrow \\ \text{velocity} \\ \text{head}}}{.0031} = .324 \text{ in } H_2O$$

and for 40°F, 50% relative humidity,

$$P_{tot} = \underset{\substack{\uparrow \\ \text{static} \\ \text{head}}}{.273} - \underset{\substack{\uparrow \\ \text{velocity} \\ \text{head}}}{.0032} = .270 \text{ in } H_2O$$

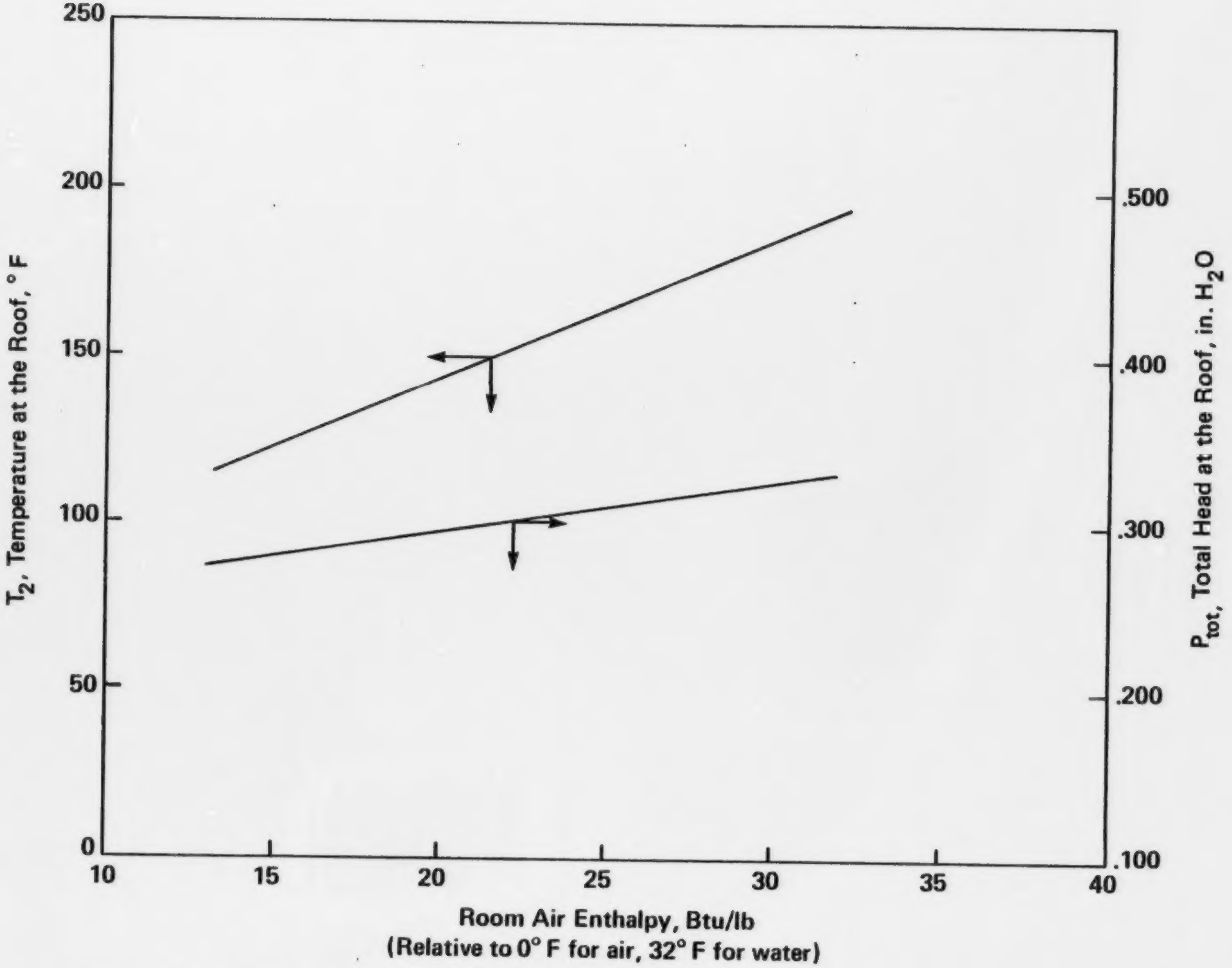
Figure 2 shows a plot of T_2 and P_{tot} for various ambient air enthalpies.

Qualitatively, it would seem that the cooler ambient air would result in a substantially higher velocity head than the warmer ambient air. In fact, it can be shown that the velocity head at the roof varies as

$$[\text{velocity head}] \ \alpha \ V_2^2 \ \alpha \ (T_s - T_a)^{.833}$$

For a source temperature of $T_s = 2600°F$, the difference in velocity head for 80°F and 40°F ambient temperature is given by

$$\left[\frac{2600°F - 80°F}{2600^2F - 40°F}\right]^{.833} = .987$$



Note: 40° F and 50% R.H. air ≅ 13 Btu/lb
80° F and 50% R.H. air ≅ 31 Btu/lb

Figure 2. Effect of ambient air enthalpy on temperature and total head at the roof.

So that there is only a 1.3% difference in velocity head for these two ambient air temperatures.

The static head varies with T_a (in °R), as follows:

$$[\text{static head}] \propto \left(\frac{1}{T_2} - \frac{1}{T_a}\right) \qquad [T] = {}^\circ R$$

For the two cases here (80°F and 40°F room temp.)

$$\frac{\frac{1}{577^\circ R} - \frac{1}{500^\circ R}}{\frac{1}{652^\circ R} - \frac{1}{540^\circ R}} = .838$$

Thus, the effect of ambient air temperature (and thus ambient air density) is greater on the static head than the velocity head. In effect, the warmer room air (80°F case) acts as an "insulator" to the rising plume of hot air. The net result is that the difference in density between the "plume air" at the roof and the ambient air is greater, resulting in a greater "bouyancy", i.e., a greater static head for this case (80°F ambient air temperature).

For either air temperature, there is sufficient total head to overcome the pressure drop associated with the roof mounted ESP.

Conclusions

1. Based on natural convection alone from a 2600°F converter mouth, an average velocity of 4.5 ft/sec over the 134 ft from the converter to the roof is calculated.
2. The total head at the roof is 0.324 in H_2O with 80°F ambient air and 0.270 in H_2O for 40°F ambient air.
3. An observed value of 9 ft/sec average (converter to roof) velocity cannot be accounted for by natural convection alone.
4. The plume diameter at the roof is 50 ft, approximately the same as the ESP (44 ft by 74 ft rectangle).
5. The volumetric flow rate of the plume at the roof is 4.54×10^5 ft^3/min. This compares to a Sumitomo design of 4.76×10^5 ft^3/min.
6. The calculated plume temperature at the roof is 192°F for 80°F ambient air and 117°F for 40°F ambient air.

Appendix B

SUMMARY
RECORD OF VISIBLE EMISSIONS

Type of Plant EAF Steel

Date 11/05/82

Company Name Tokyo Steel

Hours of Observation ______

Plant Address Hachinohe, Japan

Observer ______

Type of Discharge [✓ STACK] OTHER from REP

Discharge Location ______

Height of Point of Discharge ______

Observer's Location:

Distance to Discharge Point 120 yds North

Height of Observation Point Ground level

Direction from Discharge Point North

Background Description Sky

Weather: Clear Overcast [✓ Partly Cloudy] Other ______ Color ______

Wind Direction SW [illegible] Wind Velocity 10-15 mi/hr

Plume Description:

Detached: Yes [✓ No]

Color: Black White Other Dark Red → White (tapping)

Plume Dispersion Behavior: Looping Coning Fanning

Lofting Fumigating Other ______

Estimated Distance Plume Visible ______

Summary of Observations:

Opacity	Aggregate Time @ Opacity		Opacity	Aggregate Time @ Opacity
	min.	sec.		
0			55	
5			60	
10			65	
15			70	
20			75	
25			80	
30			85	
35			90	
40			95	
45			100	
50				

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Date 11/5/82

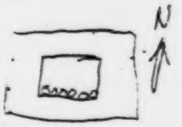
Plant Address Hachinohe

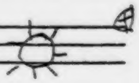
Observer Coy

Stack Location 120 yds North

Observer's Location S of Source

Weather Conditions Partly Cloudy 10-15MPH SW Position 2





TIME		SECONDS				COMMENTS
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14	30					
	31					
	32					
	33					
	34					
	35					
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	37					
	38					
	39					
	40					
	41					
	42					
	43					
	44					
Start 14	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	0	0	
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	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Date 11/5/82

Plant Address Hachinohe

Observer Coy

Stack Location 120 yds North

Observer's Location South of Source

Weather Conditions Partly Cloudy 10-15 MPH SW

HR	MIN	SECONDS 00	15	30	45	COMMENTS Position 2
15	00	0	0	0	0	
	01	0	0	0	0	
17	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
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	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
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	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	/	0	
	18	0	0	0	0	
	19	/	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	/	/	
	23	/	0	0	0	
	24	0	0	0	0	
	25	/	10	5	5	
	26	0	5	10	5	
	27	0	0	0	0	
	28	/	0	0	5	
	29	5	5	10	5	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Plant Address Hachinohe

Stack Location 120 yds North

Weather Conditions Clear

Date Nov. 5

Observer Coy

Observer's Location 120 yds South of source

TIME						COMMENTS Position 2
HR	MIN	SECONDS				
		00	15	30	45	
15	30	0	/	/	/	Interference from West monitor (5-10%)
	31	0	0	0	0	
	32	0	0	0	0	Slight haze from West + East monitors
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	Break				
	41					
	42					
	43					
	44					
	45					
	46					
	47					
	48					
	49					
	50					
	51					
	52					
	53					
	54					
	55					
	56					
	57					
	58					
	59					

SUMMARY
RECORD OF VISIBLE EMISSIONS

Type of Plant EAF Steel

Date 11/5/82

Company Name Ectays Steel

Hours of Observation ____________

Plant Address ____________

Observer MCK

Type of Discharge [✓ STACK] OTHER ____________

Discharge Location From REF

Height of Point of Discharge ____________

Observer's Location:

Distance to Discharge Point ____________

Height of Observation Point ____________

Direction from Discharge Point ____________

Background Description ____________

Weather: Clear Overcast Partly Cloudy Other ____________ Color ____________

Wind Direction ____________ Wind Velocity ____________ mi/hr

Plume Description:

Detached: Yes No

Color: Black White Other ____________

Plume Dispersion Behavior: Looping Coning Fanning Lofting Fumigating Other ____________

Estimated Distance Plume Visible ____________

Summary of Observations:

Opacity	Aggregate Time @ Opacity		Opacity	Aggregate Time @ Opacity
	min.	sec.		
0			55	
5			60	
10			65	
15			70	
20			75	
25			80	
30			85	
35			90	
40			95	
45			100	
50				

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Date Nov 5

Plant Address

Observer W.L. Klotz

Stack Location 120 yd. north

Observer's Location 2

Weather Conditions partly cloudy, 10-15mph wind SW

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
13	30	X				
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					
	41					
	42					
	43					
	44					
	45					
	46					
	47					
	48					
	49					
	50					
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name ______________________ Date Nov 5

Plant Address ______________________ Observer WLK

Stack Location ______________________ Observer's Location ______________________

Weather Conditions ______________________

HR	MIN	TIME SECONDS 00	15	30	45	COMMENTS
14	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	5	
	27	0	5	0	0	
	28	0	0	5	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name ______

Plant Address ______

Stack Location ______

Weather Conditions ______

Date Nov 5

Observer WLK

Observer's Location ______

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
10	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	/	0	truck dust
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	–
	58	0	0	0	0	
	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name ____________

Plant Address ____________

Stack Location ____________

Weather Conditions ____________

Date Nov 5

Observer WLK

Observer's Location ____________

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
TO 15	00	0	0	0	0	— end
	01	~~0~~				
	02					
	03					
	04					
	05					
	06					
	07					
	08					
	09					
	10					
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					

RECORD OF VISIBLE EMISSIONS

Company Name ____________
Plant Address ____________
Stack Location ____________
Weather Conditions CLEAR
Date NOV 5
Observer WLK
Observer's Location Position 2

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
15	30					
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	0	0	
	49	0	10	5	/	roof monitor
	50	/	0	0	0	roof monitor
	51	0	0	/	0	roof monitor
	52	/	0	0	0	roof monitor
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Plant Address Hachinohe
Stack Location 120 yds north
Weather Conditions partly cloudy - 10-15 mph wind
Date 10/5/82
Observer L. Goldman
Observer's Location 2

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
13	30					
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					
	41					
	42					
	43					
	44					
	45					
	46					
	47					
	48					
	49					
	50					
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name
Plant Address
Stack Location
Weather Conditions

Date 10/5/82
Observer L. Golfman
Observer's Location 2

HR	MIN	SECONDS 00	15	30	45	COMMENTS
14	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	0	Monitor - 5% L
37	27	0	0	0	0	
	28	0	0	5	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name
Plant Address
Stack Location
Weather Conditions

Date 12/5/82
Observer
Observer's Location 2

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
14	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	Break				
	46					
	47					
	48					
	49					
	50					
	51					
	52					
	53					
	54					
	55					
	56					
	57					
	58					
	59					

RECORD OF VISIBLE EMISSIONS

Company Name ______

Plant Address ______

Stack Location ______

Weather Conditions ______

Date 10/5/82

Observer L. Coleman

Observer's Location 2

HR	MIN	SECONDS 00	15	30	45	COMMENTS
15	00	0	0	0	0	End break
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
82	12	0	0	0	0	
	13	0	0	0	/	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	0	0	
	18	0	0	0	0	
	19	/	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	/	/	interference
	23	/	0	0	0	
	24	0	0	0	0	
	25	/	10	5	5	
	26	0	5	5	0	
	27	0	0	0	0	
	28	0	0	0	0	
	29	0	10	10	5	

RECORD OF VISIBLE EMISSIONS

Company Name
Plant Address
Stack Location
Weather Conditions

Date 10/5/82
Observer Oollman
Observer's Location

HR	MIN	TIME SECONDS 00	15	30	45	COMMENTS
15	13 00	0	/	/	/	interference - fume from monitor 5-10%
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	clear sky
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	0	0	0	
4	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	0	0	East monitor discharge
	18	0	0	0	0	
	19	0	10	10	/	interference from monitor
5	20	/	/	/	/	
	21	/	/	/	/	
	22	/	/	0	/	
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
	29	0	0	0	0	

SUMMARY
RECORD OF VISIBLE EMISSIONS

Type of Plant Electric Arc Furnace

Date Nov 6, 1982

Company Name Tokyo Steel

Hours of Observation 8:50 -

Plant Address Hachinoe, JAPAN

Observer W L Klotz

Type of Discharge [✓ STACK] OTHER ____

Discharge Location ____

Height of Point of Discharge ____

Observer's Location:

Distance to Discharge Point 120 yds.

Height of Observation Point ____

Direction from Discharge Point NW

Background Description blue sky

Weather: [✓ Clear] Overcast Partly Cloudy Other ____ Color ____

Wind Direction SW Wind Velocity 5 mi/hr

Plume Description:

Detached: Yes [✓ No]

Color: Black [✓ White] Other ____

Plume Dispersion Behavior: Looping Coning Fanning

Lofting Fumigating Other ____

Estimated Distance Plume Visible 20 yds.

Summary of Observations:

Opacity	Aggregate Time @ Opacity min.	Aggregate Time @ Opacity sec.	Opacity	Aggregate Time @ Opacity
0			55	
5			60	
10			65	
15			70	
20	–		75	
25			80	
30			85	
35			90	
40			95	
45			100	
50				

RECORD OF VISIBLE EMISSIONS

Company Name ______

Date 11/6/82

Plant Address Hachinoe, Japan

Observer WLK

Stack Location 120 yd. NW

Observer's Location position 1

Weather Conditions wind 5 mph - SW

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
8	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	5	
	33	5	5	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	5	5	5	
	58	5	5	5	5	
	59	5	5	5	5	

RECORD OF VISIBLE EMISSIONS

Company Name

Date 11/6/82

Plant Address

Observer WCK

Stack Location

Observer's Location

Weather Conditions

HR	MIN	SECONDS 00	15	30	45	COMMENTS
09 8	00	5	10	10	10	
	01	15	15	15	5	
	02	5	5	5	5	
	03	5	5	5	5	
	04	5	5	5	5	
	05	5	0	5	5	
	06	5	5	0	0	
	07	0	0	5	5	
	08	5	5	5	5	- end
	09					
	10					
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					

RECORD OF VISIBLE EMISSIONS

W/C

Company Name ______

Plant Address ______

Stack Location ______

Weather Conditions ______

Date 11/6/82

Observer ______

Observer's Location ______

6

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
	30					
	31					
	32					
	33					
	34					
9	35	10	10	5	5	
	36	5	5	5	5	
	37	5	5	5	5	
	38	5	5	5	5	
	39	5	5	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	5	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name
Plant Address
Stack Location
Weather Conditions

Date 11/6/82
Observer
Observer's Location 1

TIME						
HR	MIN	SECONDS				COMMENTS
		00	15	30	45	
10	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	5	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	0	0	→ end
	23					
	24					
	25					
	26					
	27					
	28					
	29					

RECORD OF VISIBLE EMISSIONS

Company Name ______________________

Date 11/6/82

Plant Address ______________________

Observer ______________________

Stack Location ______________________

Observer's Location 1

WK

Weather Conditions ______________________

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
10	30					
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					
	41					
	42					
	43					
	44					
	45					
	46					
	47					
	48					
	49					
	50					
	51					
	52					
	53					
	54					
	55					
	56	5	10	10	15	
	57	15	20	15	10	
	58	10	10	10	5	
	59	5	5	5	5	

RECORD OF VISIBLE EMISSIONS

Company Name

Plant Address

Stack Location

Weather Conditions

Date 11/6/82

Observer CWL Klotz

Observer's Location 1

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
11	00	5	5	5	5	
	01	5	5	5	5	
	02	5	5	5	5	
	03	5	0	0	0	
	04	0	5	0	5	
	05	0	0	0	5	
	06	5	5	0	0	
	07	0	5	10	10	
	08	10	10	10	15	
	09	20	10	5	10	
	10	5	5	10	5	
	11	5	5	5	5	
	12	5	0	5	0	
	13	5	5	5	0	
	14	0	0	0	5	
	15	0	0	0	0	
	16	0	0	0	5	
	17	5	5	5	5	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	0	0	
	23	5	5	0	0	
	24	0	0	0	5	
	25	5	0	0	0	
	26	0	0	0	0	
	27	0	0	/	/	roof monitor
	28	0	0	0	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name ______
Plant Address ______
Stack Location ______
Weather Conditions ______
Date 11/6/82
Observer W L Klotz
Observer's Location Position 1

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
11	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	/	/	Dust from roof
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	5	5	
	42	/	5	5	5	~~roof monitor~~ Change to Position 3
	43	5	5	5	5	
195	44	5	0	0	0	
	45					— break
	46					
	47					
	48					
	49					
	50					
	51					
	52					
	53					
	54					
	55					
	56					
	57					—
	58					
	59					

SUMMARY
RECORD OF VISIBLE EMISSIONS

Type of Plant EAF Steel

Date 11/6/82

Company Name

Hours of Observation

Plant Address

Observer Coy, Position

Type of Discharge [✓ STACK] OTHER

Discharge Location

Height of Point of Discharge

Observer's Location:

Distance to Discharge Point 120 yds

Height of Observation Point

Direction from Discharge Point SSE

Background Description Blue Sky

Weather: [✓ Clear] Overcast Partly Cloudy Other Color

Wind Direction SW Wind Velocity 5 mi/hr

Plume Description:

Detached: Yes [✓ No]

Color: Black White Other Reddish-Brown - White

Plume Dispersion Behavior: Looping Coning Fanning Lofting Fumigating Other

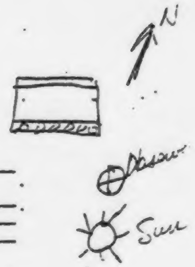
Estimated Distance Plume Visible

Summary of Observations:

Opacity	Aggregate Time @ Opacity		Opacity	Aggregate Time @ Opacity
	min.	sec.		
0			55	
5			60	
10			65	
15			70	
20			75	
25			80	
30			85	
35			90	
40			95	
45			100	
50				

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Date 1/6/82
Plant Address Hardwicke
Observer Coy
Stack Location 120 yds NNW
Observer's Location Position 1
Weather Conditions Clear
Wind SW 5MPH



TIME Start 8:22

HR	MIN	00	15	30	45	COMMENTS
0830	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	5	5	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	5	5	5	–
	58	10	5	5	5	
30	59	5	5	5	5	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Date 1/6/82
Plant Address Hachinohe
Observer Cy
Stack Location 120yds NNW
Observer's Location Position 1
Weather Conditions Clear

		TIME				COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
900	00	5	10	15	15	
	01	20	10	10	5	Smoke out of monitor (15-20)
	02	5	5	5	5	
	03	5	5	5	5	
	04	5	5	5	5	
	05	5	0	5	0	
	06	5	0	0	0	
	07	0	0	0	0	
	08	5	5	5	5	
	09	5	5	5	5	
	10	5	5	5	5	
	11	5	5	5	5	
	12	5	5	5	5	
44	13	5	5	5	5	
	14	5	5	5	10	
	15	5	5	0	0	
	16	0	0	0	5	Smoke out of east monitor (20)
	17	5	5	10	5	" "
	18	10	5	5	0	" " (15)
	19	5	0	5	0	" "
	20	5	5	/	5	" " (10-15)
	21	0	5	0	0	" " (5-10)
	22	5	0	0	0	" " ?
	23	0	0	0	0	" " ?
	24	5	5	0	5	Smoke out of east monitor (10-15)
	25	5	5	0	0	" " (5-10)
	26	0	0	5	5	
	27	0	5	/	0	
	28	0	0	0	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Date 1/6/82

Plant Address Hachinohe

Observer Cay

Stack Location 120nd sNW

Observer's Location Position 1

Weather Conditions Clear

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
-09	30	0	0	0	0	
	31	0	0	5	5	
	32	5	0	0	5	
	33	5	5	5	5	
65	34	5	5	5	5	
	35	— Break —				
	36					
	37					
	38					
	39					
	40					
	41					
	42					
	43					
	44					
	45					
	46					
	47					
	48					
	49					
	50					
	51					
	52					
	53					
	54					
	55					
	56					
	57					
	58					
	59					

RECORD OF VISIBLE EMISSIONS

Company Name Tdeyo Steel
Plant Address
Stack Location 120 yds NNW
Weather Conditions Clear
Date 11/6/82
Observer Cay
Observer's Location Position 1
Wind SW 5MPH

VE 2692

		TIME				
HR	MIN	SECONDS 00	15	30	45	COMMENTS
	00			—	End of Break —	
10	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Date 11/6/82

Plant Address Hackinoke

Observer Coy

Stack Location 120 yds NNW

Observer's Location Position 1

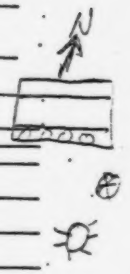
Weather Conditions Clear

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
10	30	0	0	0	0	
	31	0	0	0	0	
123	32	0	0	0	0	
	33	0	5	5	0	
	34	0	0	5	5	
	35	5	5	5	5	Smoke from east monitor (15)
	36	0	0	5	0	" " (15)
	37	0	5	0	5	" " (7)
	38	5	5	5	10	
	39	10	15	5	5	
	40	5	5	5	5	
	41	5	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	5	
	54	5	5	5	0	
146	55	0	0	0	0	
	56			Break		
	57					
	58					
	59					

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Plant Address "
Stack Location 120' NNW
Weather Conditions Clear

Date 11/6/82
Observer Coy
Observer's Location Position 1



			TIME				
	HR	MIN	SECONDS				COMMENTS
			00	15	30	45	
	11	00					
		01					
		02					
		03					
		04					
		05					
		06					
		07					
		08					
		09					
		10		Break			
		11					
		12					
		13					
		14					
		15					
		16					
		17					
		18					
		19					
171	11	20	0	0	0	0	
		21	0	0	0	0	
		22	0	0	0	0	
		23	5	5	0	0	
		24	0	0	0	5	
		25	0	0	5	5	
		26	5	0	0	0	
		27	5	5	5	5	
		28	0	0	0	0	
		29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name TokyO Steel
Plant Address
Stack Location 120 yds NNW
Weather Conditions Clear
Date 11/6/82
Observer Coy
Observer's Location Position 1

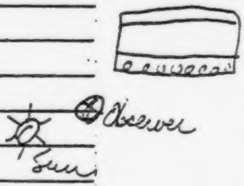
HR	MIN	00	15	30	45	COMMENTS
11	30	5	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	5	5	
	42	/	5	5	5	
	43	5	5	5	5	
	44	5	0	0	0	Shift to Position 2
	45	0	5	/	5	
	46	0	5	0	0	
198	47	0	0	0	0	
	48					Break for Lunch
	49					
	50					
	51					
	52					
	53					
	54					
	55					
	56					
	57					
	58					
	59					

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Plant Address
Stack Location 120 yds North
Weather Conditions Clear

Date 11/26/82
Observer Coy
Observer's Location Position 2
Wind ENE 5mPH

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
	30					
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38			End Lunch Break		
	39					
	40					
	41					
'99 13	42	–	0	0	0	
	43	0	0	0	/	
	44	5	5	5	5	
	45	5	5	5	5	
	46	5	5.	10	10	
	47	5	5	5	0	
	48	0	5	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	5	
	59	5	5	5	5	



RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Date 11/6/82
Plant Address
Observer Coy
Stack Location 120 yds N
Observer's Location Position 2
Weather Conditions Clear
Wind ENE 5MPH

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
14	00	5	0	5	5	
	01	5	5	5	0	
	02	0	5	5	5	
	03	5	5	5	10	
	04	5	5	5	5	
	05	5	5	5	5	
	06	5	5	0	5	
	07	0	0	/	0	Interference from front loader
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	5	5	
	13	5	5	5	5	
	14	5	5	5	5	
	15	5	5	5	5	
	16	5	5	5	5	
	17	5	5	5	5	
	18	5	5	5	5	
	19	5	5	5	5	
	20	5	5	5	0	
	21	0	5	5	0	
	22	5	5	5	5	
	23	5	0	5	5	
	24	5	5	5	5	
	25	5	5	5	5	
	26	0	/	5	5	Interference truck road dust
	27	5	5	5	5	
	28	0	5	0	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Date 11/6/82
Plant Address
Observer Coy
Stack Location 120 yds N
Observer's Location Position 2
Weather Conditions Clear

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
14	30	0	0	0	5	
	31	5	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	5	5	5	5	
	36	5	5	5	0	
	37	5	5	5	0	
	38	0	0	5	5	
	39	5	0	0	0	
	40	0	5	10	10	
	41	/	10	10	10	Interference road dust
	42	10	15	10	10	
	43	10	10	5	5	
	44	5	5	5	5	
	45	5	5	5	5	
	46	5	5	5	5	
	47	5	0	0	5	
	48	5	5	5	0	
	49	0	0	5	0	
267	50	0	0	0	0	
	51					Break
	52					
	53					
	54					
	55					
	56					
	57					
	58					
	59					

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Date 11/6/82
Plant Address
Observer Coy
Stack Location 120 yds NE
Observer's Location Position 3
Weather Conditions Clear
Wind E - 5MPH

	HR	MIN	SECONDS 00	15	30	45	COMMENTS
337	16	00	0	0	0	0	
		01	0	0	0	0	
		02	5	0	0	0	
		03	0	0	0	0	
		04	0	5	5	5	
		05	0	0	0	0	
		06	0	0	0	0	
		07	5	5	0	5	
		08	5	5	5	5	
		09	5	5	0	0	
		10	0	0	0	0	
		11	0	0	0	0	
		12	0	0	0	0	
		13	0	0	0	5	
		14	5	5	5	5	
352		15	5	5	5	5	Sweet
		~~16~~					
		17					
		18					
		19					
		20					
		21					
		22					
		23					
		24					
		25					
		26					
		27					
		28					
		29					

SUMMARY
RECORD OF VISIBLE EMISSIONS

Type of Plant EAF Shop

Date 11-6-82

Company Name Tokyo Steel

Hours of Observation 0900-1615

Plant Address Hachinohe, Japan

Observer Marvin Branscome

Type of Discharge STACK OTHER outlet roof-mounted ESP

Discharge Location Top of shop

Height of Point of Discharge __________

Observer's Location:

Distance to Discharge Point __________

Height of Observation Point __________

Direction from Discharge Point __________

Background Description clear blue sky

Weather: [✓ Clear] Overcast Partly Cloudy Other __________ Color __________

Wind Direction __________ Wind Velocity __________ mi/hr

Plume Description:

Detached: Yes No

Color: Black [✓ White] Other __________

Plume Dispersion Behavior: Looping Coning Fanning Lofting Fumigating Other __________

Estimated Distance Plume Visible __________

Summary of Observations:

Opacity	Aggregate Time @ Opacity		Opacity	Aggregate Time @ Opacity
	min.	sec.		
0			55	
5			60	
10			65	
15			70	
20			75	
25			80	
30			85	
35			90	
40			95	
45			100	
50				

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Date 11-6-82
Plant Address
Observer MB
Stack Location EAF shop
Observer's Location 1
Weather Conditions Clear
Wind NE 5-10. background=bluesky

HR	MIN	00	15	30	45	COMMENTS
	00					~~[illegible]~~ Inside shop
	01					
	02					
	03					
	04					
	05					
	06					
	07					
	08					
09	09	5	5	5	5	Start (Am)
[illegible]	10	5	5	5	5	
	11	5	5	5	5	
	12	5	5	5	5	
	13	5	10	5	5	
	14	5	5	5	5	
	15	5	5	0	0	
	16	0	0	0	5	smoke from East roof monitor;
	17	5	5	5	10	"
	18	10	5	5	0	"
50	19	0	0	0	0	"
	20	0	5	/	0	"
	21	5	0	0	0	
	22	0	0	0	5	Some emissions from E. rf monitor
	23	5	5	0	0	
	24	0	5	5	/	
	25	0	5	5	0	
	26	0	0	5	0	
	27	0	5	0	0	
	28	0	0	0	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Plant Address

Stack Location

Weather Conditions clear wind NE

Date 11-6-82

Observer MB

Observer's Location 1

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
09	30	0	0	0	0	
	31	0	0	5	5	
	32	5	5	5	5	
64	33	5	0	5	5	
	34	5	5	5	10	
	35	5	5	5	5	
	36	5	0	0	5	
	37	0	5	5	5	smoke from W monitor (very light)
	38	5	5	5	5	
	39	5	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	5	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Plant Address

Stack Location

Weather Conditions clear

Date 11-6-87

Observer MB

Observer's Location 1

VE 26 91

TIME						
HR	MIN	SECONDS				COMMENTS
		00	15	30	45	
10	00	0	0	0	0	
	01					Break
	02					
	03					
	04					
	05					
	06					
	07					
	08					
	09					
	10					
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
	19					
	20					
	21					
	22					
10	23	0	0	0	0	Start
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Plant Address

Stack Location

Weather Conditions clear

Date 11-6-82

Observer MB

Observer's Location 1

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
10	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	5	0	0	
	34	0	0	5	10	
	35	5	5	5	5	some fume from W. roof monitor
	36	0	0	0	0	"
	37	0	0	0	5	"
	38	5	5	5	10	"
	39	10	10	15	10	
	40	10	5	5	5	
	41	0	5	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	5	
	54	5	5	0	0	
	55	0	0	0	0	
147	56	5	5	10	15	
	57	15	15	20	15	Some smoke from W. monitor
	58	10	15	10	10	"
	59	10	5	5	5	

RECORD OF VISIBLE EMISSIONS

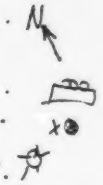
Company Name Tokyo Steel
Date 11-6-82
Plant Address
Observer MR
Stack Location
Observer's Location 1
Weather Conditions clear/calm

HR	MIN	SECONDS 00	15	30	45	COMMENTS
11	00	0	5	5	5	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	5	5	5	5	
	07	5	5	5	5	
	08	10	10	10	15	
	09	15	15	10	15	
	10	10	5	5	5	
	11	5	5	5	5	
	12	0	0	0	0	
	13	0	5	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	5	0	5	
	17	5	5	5	5	
	18	0	0	0	0	
	19	0	0	0	0	
	20					BREAK
	21					
	22					
	23					
	24					
	25					
	26				-	
	27					
	28					
	29					

VE2L MO

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Date 11-6-82
Plant Address
Observer MB
Stack Location
Observer's Location 2
Weather Conditions clear/calm

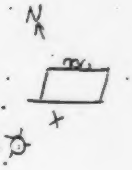


TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
	30					Break
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					
	41					
	42					
	43					Changed position
11	44					
11	45	5	5	0	0	
	46	0	5	5	0	
98	47	0	0	0	0	
	48					
	49					
	50					
	51					
	52					
	53					
	54					
	55					
	56					
	57					
	58					
	59					

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Plant Address
Stack Location
Weather Conditions Clear 5-10 ENE wind
Background: blue sky

Date 11-6-82
Observer MB
Observer's Location 2



TIME HR	MIN	SECONDS 00	15	30	45	COMMENTS
	30					
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					
	41					
13	42	0	0	5	0	
	43	0	0	5	~~5~~	interference @ 43:45
	44		5	5	5	interf. @ 44:00
	45	5	5	5	5	
	46	5	5	10	15	
	47	10	5	5	5	
	48	5	5	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	5	0	0	0	
	57	0	0	0	0	
	58	0	0	5	5	
	59	5	5	5	5	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Date 11-6-82

Plant Address

Observer MB

Stack Location

Observer's Location 2

Weather Conditions Clear wind ENE @ 5-10

HR	MIN	SECONDS 00	15	30	45	COMMENTS
14	00	5	5	5	5	
	01	5	5	5	0	
	02	0	5	5	0	
	03	5	5	5	5	
	04	5	5	5	5	
	05	5	5	5	5	
	06	5	5	5	5	
	07	5	5	5	0	Interference
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	5	5	5	5	
	13	5	5	5	5	
VE16	14	5	10	10	10	
232	15	5	10	10	10	
	16	5	5	5	5	
	17	5	5	5	5	
	18	5	5	5	5	
	19	5	5	5	5	
	20	5	5	5	5	
	21	5	5	5	5	
	22	0	0	5	5	
	23	5	5	0	5	
	24	5	5	5	5	
	25	5	5	5	5	
	26	5	5	5	5	
	27	5	5	5	5	
	28	0	0	5	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name Toledo Steel

Date 11-6-82

Plant Address

Observer mb

Stack Location

Observer's Location 2

Weather Conditions

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
	30	0	0	5	5	
	31	0	5	5	5	
14	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	5	
252	35	5	5	5	5	
	36					Break
	37					
	38					
	39					
	40					
	41					
	42					
	43					
	44					
	45					
	46					
	47					
	48					
	49					
	50					
14	51	0	5	0	5	
269	52	5	5	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Date 11-6-82
Plant Address
Observer MB
Stack Location
Observer's Location 2
Weather Conditions Clear

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
15	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
2,89	12	0	0	0	0	
	13	0	0	0	5	
	14	5	5	5	5	
	15	5	0	0	5	
	16	5	10	10	5	
	17	5	10	5	5	
	18	5	5	5	5	
	19	5	5	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Plant Address
Stack Location
Weather Conditions clear ENE 5-10

Date 11-6-82
Observer MB
Observer's Location 2/3

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
15	30	0	0	0	0	
	31	0	0	0	0	Changed to position 3
	32	0	0	0	0	
	33	0	0	0	0	
311	34	0	0	0	0	
	35	5	5	5	5	
	36	5	5	5	5	
	37	5	5	5	5	
	38	5	5	5	5	
	39	5	0	0	0	
	40	0	0	0	0	
	41	0	0	0	5	
	42	5	5	5	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	5	5	0	
	47	5	5	5	5	
	48	5	5	5	5	
326	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
336	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name ____________
Date 10/6/82
Plant Address ____________
Observer L. Goldman
Stack Location ____________
Observer's Location #2
Weather Conditions clear

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
14	30					
	31					
	32					
	33					
	34					
	35					
	36	5	5	5	0	
	37	0	5	5	5	
	38	0	0	5	5	
	39	5	0	0	0	
	40	0	5	10	15	
	41	/	10	10	10	truck dust
	42	15	15	10	10	
	43	10	10	5	5	
	44	5	/	5	5	interference
	45	5	5	5	5	
	46	5	5	5	5	
	47	0	5	0	5	
	48	0	0	5	5	
VE16	49	0	0	0	0	
267	50	0	0	0	0	
VE 26 268	51	0	0	0	0	
	52	0	0	0	5	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name ____________________
Plant Address ____________________
Stack Location ____________________
Weather Conditions ____________________

Date 10/6/82
Observer L. Golfman
Observer's Location 2

		TIME				
HR	MIN	SECONDS				COMMENTS
		00	15	30	45	
1500	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	5	
	14	5	5	5	5	
	15	0	5	0	10	
	16	10	15	10	10	
	17	5	10	10	5	
	18	5	10	10	5	
	19	5	0	0	0	
297	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name ____________

Plant Address ____________

Stack Location ____________

Weather Conditions ____________

Date 10/6/82

Observer L. Coll

Observer's Location 2 & 3

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
-15	30	0	0	0	0	~~[illegible]~~
	31	0	0	0	0	change to new location
	32	0	0	0	0	
310	33	0	0	0		
	34					
	35					
	36					
	37					
	38					Break
	39					
	40					
	41					
	42					
	43					
	44					
	45					
	46					
	47					
	48		5	5	5	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
936	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name
Plant Address
Stack Location
Weather Conditions
Date 10/6/92
Observer C. [illegible]
Observer's Location 3

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
1600	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
VEIL	04	0	0	0	5	
	05	5	0	0	0	
	06	0	0	0	5	
	07	5	5	0	5	
	08	5	10	10	5	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	5	
	14	5	5	5	5	
352	15	5	5	5	5	finish reading
	16					
	17					
	18					
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26			—		
	27					
	28					
	29					

SUMMARY
RECORD OF VISIBLE EMISSIONS

Type of Plant EAF

Date 11/7/82

Company Name Tokyo Steel

Hours of Observation 8:00Am - 3:47Pm

Plant Address Hachinohe Japan

Observer

Type of Discharge STACK OTHER

Discharge Location ESP - Roof

Height of Point of Discharge

Observer's Location:

Distance to Discharge Point

Height of Observation Point

Direction from Discharge Point S - SW

Background Description Sky & ESP (Brown)

Weather: Clear Overcast [✓ Partly Cloudy] Other Color

Wind Direction Wind Velocity mi/hr

Plume Description:

Detached: Yes No

Color: Black White Other White or slightly brown

Plume Dispersion Behavior: Looping Coning [✓ Fanning] Lofting Fumigating Other

Estimated Distance Plume Visible 20 yds

Summary of Observations:

Opacity	Aggregate Time @ Opacity min.	sec.	Opacity	Aggregate Time @ Opacity
0			55	
5			60	
10			65	
15			70	
20			75	
25			80	
30			85	
35			90	
40			95	
45			100	
50				

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Date Nov 7, 1982
Plant Address HAchinoe JApAn
Observer W.L. Klotz
Stack Location 120 yd. NW
Observer's Location position 1
Weather Conditions overcast, wind 5mph SE

VE17

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
~~8~~	00	~~0~~	~~0~~	~~0~~		
	01					
	02					
	03					
	04					
	05					
	06					
	07					
	08					
	09					
	10					
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
	19					
	20					
	21					
8	22	0	0	0	0	START
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name
Plant Address
Stack Location
Weather Conditions
Date Nov 7, 1982
Observer WL Kidd
Observer's Location position 1

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
8	30	5	10	10	10	
	31	10	/	5	5	truck exhaust
	32	5	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	0	0	
	49	5	10	10	5	
	50	5	5	5	0	
	51	0	0	0	0	
	52	0	0	0	10	
	53	0	0	0	5	
	54	5	5	5	5	
	55	5	/	0	0	Diesel exhaust
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Date Nov 7, 1982
Plant Address
Observer CWKlotz
Stack Location
Observer's Location position 1
Weather Conditions

HR	MIN	SECONDS 00	15	30	45	COMMENTS
9	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	5	
48	09	5	5	5	5	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20					Break
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					

RECORD OF VISIBLE EMISSIONS

Company Name ____________
Plant Address ____________
Stack Location ____________
Weather Conditions ____________

Date Nov 7, '82
Observer W C Klotz
Observer's Location 1

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
9	30					
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					Finish break
79	40	0	0	0	0	Start I
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	5	5	5	
	44	5	5	5	5	
	45	5	0	0	0	
	46	0	5	0	0	
	47	0	0	0	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name Tolago steel
Date Nov 7, 1982
Plant Address
Observer W L Klotz
Stack Location
Observer's Location 1
Weather Conditions

HR	MIN	TIME SECONDS 00	15	30	45	COMMENTS
10	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
113	14	0	0	0	0	Stop reading
	15					
	16					
	17					Furnace Room - Crane Repair
	18					
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26				-	
	27	0	0	0	0	start
	28	0	0	0	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name ____________

Date Nov 7, 1982

Plant Address ____________

Observer WL Klotz

Stack Location ____________

Observer's Location 1

Weather Conditions ____________

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
10	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	5	5	
	49	5	5	5	5	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	Position 2
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	Start
158	59	0	0	0	0	Break

RECORD OF VISIBLE EMISSIONS

Company Name
Date Nov 7, 1982
Plant Address
Observer W L Klotz
Stack Location 120 yds N
Observer's Location 2
Weather Conditions Clear, wind 0-5 mph SW

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
11	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Date Nov 2, 1982
Plant Address
Observer WLKelly
Stack Location
Observer's Location 2
Weather Conditions clear, wind 0-5 mph SW

HR	MIN	TIME SECONDS 00	15	30	45	COMMENTS
12	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
240	21	0	0	0	0	
	22	0	0	5	5	
	23	5	5	5	5	
	24	5	5	10	5	
	25	5	10	10	15	
	26	5	0	0	5	
	27	5	5	5	5	
	28	0	0	0	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name ______________

Date Nov 7, 1982

Plant Address ______________

Observer [illegible]

Stack Location ______________

Observer's Location 2

Weather Conditions Clear, wind 0-5 SW

TIME HR	MIN	SECONDS 00	15	30	45	COMMENTS
12	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
257	38	0	0	0	0	break for lunch
	39					
	40					
	41					
	42					
	43					
	44					
	45					
	46					
	47					
	48					
	49					
	50					
	51					
	52					
	53					
	54					
	55					
	56					
	57					
	58					
	59					

RECORD OF VISIBLE EMISSIONS

Company Name

Plant Address

Stack Location

Weather Conditions clear, wind 0-5 mph SW

Date Nov 7, 1982

Observer WC Klotz

Observer's Location #2

2:2

HR	MIN	00	15	30	45	COMMENTS
	00	⊗				
	01					
	02					
	03					
	04					
	05					
	06					
	07					
	08					
	09					
	10					
	11					
	12					
13	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	5	5	5	5	
	17	5	0	0	0	
	18	0	5	5	5	
	19	5	5	5	5	
	20	5	5	5	5	
	21	5	5	5	5	
	22	0	0	0	0	
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Date Nov 7, 1982

Plant Address

Observer W L Klotz

Stack Location

Observer's Location 2

Weather Conditions clear, wind 0-5mph SW

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
13	30	0	0	0	0	
	31	0	0	5	0	
	32	0	0	0	0	
	33	0	0	5	5	
	34	5	0	0	0	
	35	0	0	0	0	
	36	5	5	5	5	
	37	5	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	5	0	0	
	42	0	0	0	5	
	43	5	5	5	5	
	44	0	5	5	0	
	45	0	0	0	0	
	46	5	5	5	5	
	47	5	5	5	5	
	48	5	5	5	5	
	49	0	0	0	0	
	50	5	5	5	5	
	51	5	5	5	5	
	52	5	5	5	5	
	53	5	5	5	5	
	54	5	5	5	5	
	55	5	5	5	5	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
138	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name ______

Plant Address ______

Stack Location ______

Weather Conditions ______

Date Nov 7, 1982

Observer WL Klotz

Observer's Location 2

		TIME				
HR	MIN	SECONDS				COMMENTS
		00	15	30	45	
14	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	5	5	5	5	
	05	5	5	5	5	
	06	5	0	0	0	
	07	0	5	5	5	
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	5	5	5	0	
	12	0	0	0	0	
	13	0	0	5	5	
	14	5	5	10	5	
	15	5	5	5	5	
	16	5	5	5	0	
	17	0	0	0	0	
	18	0	0	0	0	
358	19	0	0	0	0	
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					

Company Name ____________________

Plant Address ____________________

Stack Location ____________________

Weather Conditions Overcast

Date Nov 7, 1982

Observer ____________________

Observer's Location WLKloty Position 3

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
	30					
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					
	41					
	42					
	43					
	44					
384 14	45	5	5	5	/	— Position 3
14	46	5	5	5	5	
	47	5	5	5	5	
	48	0	0	0	0	
	49	0	10	10	10	
	50	10	10	5	5	
	51	10	10	10	10	
	52	15	15	10	5	
	53	10	10	10	5	
	54	10	10	10	10	
	55	5	5	5	5	
	56	0	0	0	0	
	57	0	5	5	5	
	58	5	0	0	0	
	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name ____________________
Plant Address ____________________
Stack Location ____________________
Weather Conditions overcast

Date Nov 7, 1982
Observer WLKlotz
Observer's Location 3

HR	MIN	SECONDS 00	15	30	45	COMMENTS
15	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	0	0	
422	23	0	0	5	5	
	24					
	25					
	26					
	27					
	28					
	29					

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Date 11-7-82
Plant Address Hachinohe Japan
Observer MRB
Stack Location
Observer's Location 2
Weather Conditions 50% cloudy Wind 0-3 SW
Background - ESP

VE17 359

HR	MIN	TIME				COMMENTS
		SECONDS				
		00	15	30	45	
	00					
	01					
	02					
	03					
	04					
	05					
	06					
	07					
	08					
	09					
	10					
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
	19					START 11-7-82
14	20	0	0	0	0	Relief for Kratz
	21	0	0	5	5	
	22	5	5	5	5	
	23	5	5	5	10	
	24	10	5	10	5	
	25	10	10	5	5	
	26	0	0	0	0	
	27	0	5	0	5	
	28	5	5	5	5	
	29	5	5	5	5	

RECORD OF VISIBLE EMISSIONS

②

Company Name Tokyo Steel

Date 11-7-82

Plant Address Hachinohe, Japan

Observer MRB

Stack Location

Observer's Location 2/3

Weather Conditions 50% cloudy Wind SW 0-3 mph

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
14	30	5	5	5	5	
	31	5	5	5	5	
	32	5	5	5	5	
	33	5	5	5	5	
	34	5	5	5	5	
	35	5	5	5	5	
	36	5	5	5	5	
	37	5	5	5	5	
	38	5	5	10	0	
	39	5	0	0	0	
	40	0	5	10	10	
	41	10	10	10	10	
	42	10	5	5	5	
	43	5	10	15	10	
383	44	15	10	5	5	
	45	5	5	5	/	CHanged to Position 3 (Relief for Goldman)
	46	5	5	5	0	
	47	0	0	0	0	
	48	0	0	0	0	
	49	0	10	15	15	
	50	10	10	10	10	
	51	10	10	10	10	
	52	10	10	10	10	
	53	10	10	5	10	
	54	10	15	10	10	
	55	5	5	0	0	
	56	0	0	5	0	
	57	0	5	5	5	
	58	0	0	0	0	
398	59	0	0	0	0	

③ NR

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Date 11-7-82
Plant Address Hachinohe, Japan
Observer MRB
Stack Location
Observer's Location 3
Weather Conditions 50% cloudy Wind 0-3 SW

	TIME						COMMENTS
	HR	MIN	SECONDS				
			00	15	30	45	
	15	00	0	0	0	0	
		01	0	0	0	0	
		02	0	0	0	0	
		03	0	0	0	0	
		04	0	0	0	0	
		05	0	0	0	0	
		06	0	0	0	0	
		07	0	0	0	0	
1627		08	0	0	0	0	
408		09	0	0	0	0	
		10					BREAK
		11					
		12					
		13					
		14					
		15					
		16					
		17					
		18					
		19					
		20					
		21					
		22					
VE17		23					
423	15	24	0	0	0	0	Relief for [illegible]
		25	0	0	0	0	
		26	0	0	0	0	
		27	0	0	0	0	
		28	0	0	0	5	
		29	5	5	5	5	

RECORD OF VISIBLE EMISSIONS

④

Company Name Teledyne Steel

Date 11-7-82

Plant Address

Observer MB

Stack Location

Observer's Location 3

Weather Conditions 50% cloudy

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
15	30	5	5	5	5	
	31	5	5	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
VE17	46	0	5	5	5	
446	47	5	0	0	0	
	48					
	49					
	50					
	51					
	52					
	53					
	54					
	55					
	56					
	57					
	58					
	59					

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Plant Address

Stack Location 120 yds NNW

Weather Conditions Overcast

Date 11/7/82

Observer Cory

Observer's Location Position 1

Wind SW - 5-8 MPH

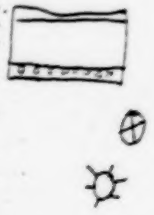
TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
09	00					
	01					
	02					
	03					
	04					
	05					
	06					
	07					
	08					
	09					
	10					
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
	19					
09	20	0	0	0	0	Relief for Klotz
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	5	0	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name TokyO Steel
Date 11/7/82
Plant Address
Observer Coy
Stack Location
Observer's Location 1
Weather Conditions Overcast / Partly Cloudy
Wind SW 5-8 mph

8:08 AM Start

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
09	30	0	0	0	/	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
78	39	0	0	0	0	
VE 27 79	40	0	0	0	0	— Relief for Gottman
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	5	5	5	
	44	0	5	5	5	Smoke from east monitor. (10)
	45	5	5	5	0	
	46	5	5	0	5	
	47	0	5	0	0	
	48	0	0	0	0	
	49	0	0	0	0	Smoke from east roof monitor (5-10)
	50	0	0	0	0	
	51	0	0	0	0	" " " (<5)
	52	0	0	0	0	" " " "
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	



Partly Cloudy

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Plant Address "

Stack Location 120 yds NW

Weather Conditions Partly Cloudy

Date 11/7/82

Observer Coy

Observer's Location 1

Wind SW - 5 MPH

HR	MIN	SECONDS 00	15	30	45	COMMENTS
10	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
113	14	0	0	0	0	Break
	15					
	16					
	17					
	18					
	19					
	20					
	21					Furnace Down Crane Repair
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Plant Address
Stack Location 120 yds N
Weather Conditions Clear
Date 1/7/82
Observer Cox
Observer's Location 2
Wind SW- <5MPH

VE 17
157

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
11	00	0	0	0	0	Relief for Klef
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	5	0	0	0	
	09	5	5	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	0	0	
	18	0	0	0	5	
	19	0	0	0	0	
	20	5	5	0	0	
	21	0	0	0	0	
	22	0	5	0	0	
	23	0	0	5	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name TakyO Steel

Plant Address

Stack Location 120 yds N

Weather Conditions Clear

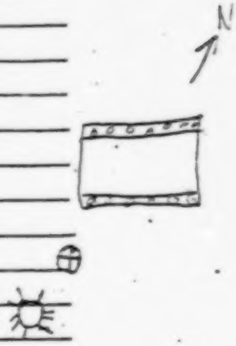
Date 11/1/82

Observer Coy

Observer's Location 2

Wind SW

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
11	30	0	0	0	0	Relief for Goldman
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	/	/	0	0	– West monitor smoke interference (15-20)
	58	0	0	0	0	
	59	0	0	0	0	



RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Plant Address

Stack Location 120 yds N

Weather Conditions Clear

Date 11/4/82

Observer Coy

Observer's Location Position 2

Wind SW

VE 17
258

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
12	30					
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
12	39	0	0	0	0	Relief for Klotz
12	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	5	5	5	10	
	45	15	~~5~~	/	5	Interference from west monitor (15-20)
	46	/	0	0	0	" " "
	47	0	0	0	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	5	5	
	52	5	5	5	5	
	53	5	5	5	5	
	54	5	5	5	5	
	55	5	5	5	5	
	56	5	5	5	5	
	57	5	5	5	5	
	58	5	0	5	5	
	59	5	5	5	5	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Plant Address

Stack Location 120 yds N

Weather Conditions Clear

Date 11/7/82

Observer Coy

Observer's Location 2

Wind SW - 5MPH

HR	MIN	SECONDS 00	15	30	45	COMMENTS
13	00	5	5	0	5	
	01	5	5	5	5	
	02	5	5	5	5	
	03	5	5	5	5	
	04	5	0	5	0	
	05	5	5	5	0	
	06	0	5	0	0	
	07	0	0	0	5	
	08	0	5	5	0	
	09	0	0	0	0	
	10	5	5	5	0	
VE17	11	0	0	5	5	
291	12	0	0	0	0	
27 292	13	0	5	0	0	Relief for Goldman
	14	0	0	0	0	
	15	0	0	0	0	
	16	5	5	5	5	
	17	5	0	0	0	
	18	0	0	0	5	
	19	5	5	5	5	
	20	5	5	5	5	
	21	5	5	5	0	
	22	0	0	0	0	
	23	0	0	0	0	
	24	0	0	0	0	
	25	5	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name TokyO Steel
Plant Address
Stack Location 120 yds N
Weather Conditions Clear

Date 11/7/82
Observer Coy
Observer's Location 2
Wind SW - < 5mPH

TIME						
HR	MIN	SECONDS				COMMENTS
		00	15	30	45	
13	30	0	0	0	0	
	31	0	0	5	0	
	32	0	0	0	0	
	33	0	0	5	5	
	34	0	0	0	0	
	35	0	0	0	0	
	36	5	0	0	5	
	37	0	0	0	0	
	38	0	5	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	5	5	0	5	
	42	0	0	5	5	
	43	0	5	0	5	
	44	5	5	5	0	
	45	0	0	0	0	
	46	5	5	5	5	
	47	5	5	5	5	
	48	5	5	5	5	
	49	0	0	0	0	
	50	5	5	5	5	
	51	5	5	5	5	
	52	5	5	5	5	
	53	5	5	5	5	
333	54	5	5	5	5	Break
	55					
	56					
	57					
	58					
	59					

RECORD OF VISIBLE EMISSIONS

Company Name ________________ Date 11/7/82

Plant Address ________________ Observer L. Goldman

Stack Location ________________ Observer's Location 1

Weather Conditions ________________

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
800	00					
	01					
	02					
	03					
	04					
	05					
	06					
	07					
	08					
	09					
	10					
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
	19					
	20					
	21					
	22	0	0	0	0	start
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
	29	0	0	5	5	

RECORD OF VISIBLE EMISSIONS

Company Name ______

Plant Address ______

Stack Location ______

Weather Conditions ______

Date 11/7/92

Observer L. Colfm

Observer's Location 1

TIME HR	MIN	SECONDS 00	15	30	45	COMMENTS
800	30	5	15	10	5	monitor emissions
	31	5	/	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	East roof monitor emissions 15-30%
27	48	0	0	0	0	" "
	49	5	10	5	5	" "
	50	5	5	5	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	5	5	5	
	55	5	/	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name ____________________
Plant Address ____________________
Stack Location ____________________
Weather Conditions ____________________

Date 11/7
Observer ____________________
Observer's Location ____________________

HR	MIN	SECONDS 00	15	30	45	COMMENTS
9	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	5	0	
	09	5	5	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name
Date 11/7/82
Plant Address
Observer L. Goldman
Stack Location
Observer's Location 1
Weather Conditions

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
09	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
78	39	0	0	5	0	
	40					
	41					
	42					
	43					
	44					
	45					
	46					
	47					
	48					
	49					
	50					
	51					
	52					
	53					
	54					
	55					
	56					
	57					
	58					
	59					

RECORD OF VISIBLE EMISSIONS

Company Name
Plant Address
Stack Location
Weather Conditions
Date 11/7/82
Observer L. Coleman
Observer's Location 1

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
10	00					
	01					
	02					
	03					
	04					
	05					
	06					
	07					
	08					
	09					
	10					
	11					
	12					
	13					
	14					
	15					
	16					Furnace down, crane repair
	17					
	18					
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
128	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name ____________________ Date 11/7

Plant Address ____________________ Observer L. Goldman

Stack Location ____________________ Observer's Location 1

Weather Conditions mostly overcast

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
10	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	0	5	
	49	0	0	5	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name

Plant Address

Stack Location

Weather Conditions clearing - wind 0-5 SW

Date 11/3/82

Observer Coltman

Observer's Location 2

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
11	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	5	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	5	5	0	
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
	29	0	0	0	0	

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RECORD OF VISIBLE EMISSIONS

Company Name

Plant Address

Stack Location

Weather Conditions

Date 11/7/82

Observer L. Cohfmen

Observer's Location S

VE 27
219

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
720	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	5	5	0	
	23	0	0	5	0	
	24	5	10	10	5	
	25	5	10	15	10	
	26	5	0	0	5	
	27	5	5	0	0	
	28	0	0	0	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name ______

Plant Address ______

Stack Location ______

Weather Conditions 0-15 SW clear sky

Date 11/7/82

Observer L. Coffman

Observer's Location 2

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
12	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	5	5	10	
	45	15	/	/	/	Vent monitor emissions
	46	/	0	/	0	
	47	0	0	0	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	5	
	52	0	5	5	5	
	53	5	5	5	5	
	54	5	5	5	5	
	55	5	5	5	5	
	56	5	10	5	5	
	57	5	5	5	5	
	58	5	5	5	5	
218	59	5	5	5	5	

RECORD OF VISIBLE EMISSIONS

Company Name ____________

Plant Address ____________

Stack Location ____________

Weather Conditions Clear

Date 11/7/82

Observer Z. Eckelman

Observer's Location 2

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
13	00	5	5	5	5	
	01	5	5	5	5	
	02	5	5	5	5	
	03	0	5	5	0	
	04	0	5	0	0	
	05	0	5	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	0	0	0	
	10	5	0	5	0	
	11	0	0	0	0	
291	12	0	0	0	0	
	13					
	14					
	15					
	16					
	17					Break
	18					
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					

RECORD OF VISIBLE EMISSIONS

Company Name
Plant Address
Stack Location
Weather Conditions

Date 11/7/82
Observer L. Goldman
Observer's Location

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
13	30					
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					
	41					
	42					
	43					
	44					
	45					
	46					
	47					
	48					
	49					
	50					
	51					
	52					
	53					
	54					
334	55	5	5	5	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name
Plant Address
Stack Location
Weather Conditions pthy cloudy

Date 11/7/82
Observer L. Goldman
Observer's Location 2

HR	MIN	TIME SECONDS 00	15	30	45	COMMENTS
14	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	5	10	5	
	05	5	5	5	5	
	06	0	5	0	0	
	07	5	0	5	5	
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	5	5	0	
	12	0	0	0	0	
	13	0	0	5	5	
	14	5	10	10	5	
	15	5	5	0	5	
	16	0	0	0	0	
	17	0	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	5	5	0	
	22	5	5	5	5	
	23	5	5	5	5	
	24	10	10	5	5	
	25	5	5	5	5	
	26	5	0	0	0	
	27	0	5	5	5	
	28	0	5	5	5	
368	29	5	0	5	5	

RECORD OF VISIBLE EMISSIONS

Company Name ______________

Date 11/7/82

Plant Address ______________

Observer L. Goldman

Stack Location ______________

Observer's Location 2

Weather Conditions mostly cloudy

TIME HR	MIN	SECONDS 00	15	30	45	COMMENTS
14	30	5	0	0	5	
	31	5	5	0	5~~0~~	roof monitor - east end
	32	5	0	5	5	
	33	5	5	0	5	
	34	5	5	5	0	
	35	5	5	5	5	
	36	5	5	0	5	
	37	5	5	5	0	
	38	5	5	5	0	
	39	5	0	0	0	
	40	0	5	10	10	
	41	10	10	15	10	
	42	10	5	5	5	
	43	10	15	10	10	
	44	10	5	5	5	Break
	45					
	46					
	47					
	48					
	49					
	50					
	51					
	52					
	53					
	54					
	55					
	56					
	57					
	58					
	59					

RECORD OF VISIBLE EMISSIONS

Company Name

Plant Address

Stack Location

Weather Conditions overcast -

Date 11/7/82

Observer L- Coldham

Observer's Location #3

HR	MIN	TIME SECONDS 00	15	30	45	COMMENTS
15	00					
	01					
	02					
	03					
	04					
	05					
	06					
	07					
	08					
	09					
409	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	5	
	29	10	5	5	5	

Company Name ______________________

Plant Address ______________________

Stack Location ______________________

Weather Conditions ptly cldy

Date 11/7/82

Observer L-Goldman

Observer's Location #3

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
B15	30	5	5	5	5	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
JE27	46	0	5	5	5	
446	47	0	0	0	0	
	48					
	49					Finish
	50					
	51					
	52					
	53					
	54					
	55					
	56					
	57					
	58					
	59					

SUMMARY
RECORD OF VISIBLE EMISSIONS

Type of Plant EAF Steel
Date 11/8/82
Company Name Tokyo Steel
Hours of Observation 0817-
Plant Address Hachinohe, Japan
Observer Coy
Type of Discharge ~~STACK~~ [✓ OTHER] RED
Discharge Location ~~120 yds~~ Top of building
Height of Point of Discharge
Observer's Location:
Distance to Discharge Point 120 yds
Height of Observation Point
Direction from Discharge Point 120 yds S55E
Background Description Broken Sky
Weather: Clear Overcast [✓ Partly Cloudy] Other Color
Wind Direction West Wind Velocity 5 mi/hr
Plume Description:
Detached: Yes [✓ No]
Color: Black [✓ White] Other Reddish-Brown
Plume Dispersion Behavior: Looping Coning Fanning Lofting Fumigating Other
Estimated Distance Plume Visible

Summary of Observations:

Opacity	Aggregate Time @ Opacity		Opacity	Aggregate Time @ Opacity
	min.	sec.		
0			55	
5			60	
10			65	
15			70	
20			75	
25			80	
30			85	
35			90	
40			95	
45			100	
50				

RECORD OF VISIBLE EMISSIONS

Company Name Takno Steel

Date 11/8/82

Plant Address Hachinoke

Observer Coy

Stack Location 120 yds NNW

Observer's Location 1

Weather Conditions Partly Cloudy

Wind West - 5MPH

HR	MIN	SECONDS 00	15	30	45	COMMENTS
08	00					8:08 Start Time
	01					
	02					
	03					
	04					
	05					
	06					
	07					
	08					
	09					
	10					
	11					
	12					
	13					
	14					
	15					
	16					
08	17	0	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	5	
	26	0	0	0	0	
	27	5	5	5	5	
	28	5	5	5	5	
	29	5	5	5	5	

RECORD OF VISIBLE EMISSIONS

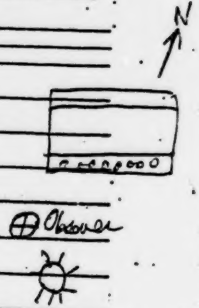
Company Name
Plant Address
Stack Location 1204N
Weather Conditions Partly Cloudy
Date 11/8
Observer Coy
Observer's Location Position 1 → 2

TIME

HR	MIN	SECONDS				COMMENTS Wind WNW - 5MPH
		00	15	30	45	
08	30	10	15	10	10	Plume coming toward us
	31	/	/	/	/	Shift position to Position 2
	32	/	/	/	/	
	33	5	0	0	5	
	34	0	0	0	0	
	35	5	0	0	0	
	36	0	5	0	0	
	37	5	5	5	5	
	38	10	5	10	10	
	39	10	10	5	10	
	40	15	10	5	5	
	41	5	5	10	10	
	42	5	5	5	5	
	43	5	5	5	5	
	44	0	0	0	5	
	45	0	0	5	0	
	46	0	0	0	0	
	47	0	0	0	0	
VE 18	48	0	0	0	0	
33	49	0	0	0	0	
	50					Break
	51					
	52					
	53					
	54					
	55					
	56					
	57					
	58					
	59					

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Date 11/8/82
Plant Address
Observer Coy
Stack Location
Observer's Location 2
Weather Conditions Partly Cloudy
Wind NW - 5MPH



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HR	MIN	00	15	30	45	COMMENTS
09	00					
	01					
	02					
	03					
	04					
	05					
	06					
	07					
	08					
	09					
	10					
	11					
	12					
	13					
	14					
	15					
	16					Break over
09	17	5	5	5	5	
	18	5	5	5	5	
	19	5	0	5	5	
	20	0	5	5	5	
	21	5	5	0	0	
	22	0	/	/	0	
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	5	
	26	5	5	0	0	
	27	0	5	5	0	
	28	0	0	0	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Date 11/8/82
Plant Address
Observer Coy
Stack Location
Observer's Location 2
Weather Conditions Partly Cloudy - Scattered

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
09	30	0	0	0	0	
	31	0	5	0	0	Smoke from east monitor (10)
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	5	0	5	
	42	0	0	0	5	
	43	5	5	5	5	
	44	5	5	0	0	
	45	0	0	0	0	
	46	5	0	5	5	
	47	0	0	5	0	Smoke out of east monitor (15)
	48	5	15	20	10	
	49	10	15	10	10	2nd charge crane operator
	50	5	15	15	20	dumped part of charge on furnace
	51	15	20	10	10	
	52	10	5	10	15	
	53	/	/	/	/	Interference from east monitor
	54	/	/	/	5	″
	55	5	5	5	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
103	59	0	0	0	0	Break

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Plant Address

Stack Location 120 yds N

Weather Conditions Scattered Clouds

Date 11/8/82

Observer Coy

Observer's Location 2

Wind NW - 5MPH

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
10	30	5	0	5	5	
	31	5	0	5	0	
	32	0	0	0	0	
	33	5	0	0	0	
	34	0	0	/	0	Road dust
	35	0	5	5	5	
	36	5	5	5	5	
	37	5	5	0	0	
	38	0	0	0	0	
	39	5	0	0	0	Wind Shift - NE
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	5	
	48	5	0	5	10	
	49	10	10	5	10	
	50	5	5	5	5	
	51	5	5	10	5	
	52	5	5	5	5	
	53	5	5	5	5	
	54	5	5	0	0	
	55	0	0	/	/	Interference from east roof monitor
	56	/	5	5	0	
	57	0	0	0	0	
	58	0	0	0	0	
163	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Date 11/8/82

Plant Address

Observer Goy

Stack Location 120 yds N

Observer's Location 2

Weather Conditions Scattered Clouds

Wind N

HR	MIN	SECONDS 00	15	30	45	COMMENTS
11	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	5	5	
	22	0	0	0	5	
	23	0	5	5	5	Smoke from east monitor
	24	5	10	/	/	Interference "
	25	5	5	5	5	
	26	10	10	5	10	
	27	10	10	20	20	
	28	15	/	/	/	Plume coming toward us
193	29	5	5	5	5	

Break

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Plant Address
Stack Location 120 yds N
Weather Conditions Scattered Clouds

Date 11/8/82
Observer Coy
Observer's Location 2
Winds - NNW

HR	MIN	TIME SECONDS 00	15	30	45	COMMENTS
12	00					
	01					Break
	02					
	03	0	0	0	0	
	04	0	0	0	0	
	05	5	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
233	09	5	5	5	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	5	5	
	18	0	0	0	0	
	19	0	0	5	5	
	20	5	0	5	0	
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	5	5	5	5	
	27	5	5	5	/	East roof monitor interference (10)
	28	/	/	/	/	~ 5% but interference
253	29	/	/	/	0	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Plant Address
Stack Location 120 yds N
Weather Conditions Scattered Clouds

Date 11/8/82
Observer Coy
Observer's Location 2
Wind - NNW

HR	MIN	00	15	30	45	COMMENTS
12	30	0	0	0	0	
	31	0	5	5	0	
	32	0	0	5	5	
	33	/	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	5	5	5	5	
	47	5	0	0	0	
	48	5	0	5	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	5	5	5	5	
	53	5	5	10	10	
	54	10	10	/	/	Plume coming toward observers
	55	/	15	/	10	
	56	5	5	5	5	
	57	5	5	5	5	
	58	10	10	/	/	
283	59	10	10	/	5	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Date 11/8/82
Plant Address
Observer Coy
Stack Location 120 yd N
Observer's Location 2
Weather Conditions Clear

287

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
13	00	5	5	5	0	
	01	0	5	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	5	5	0	5	
	09	0	5	5	5	
	10	0	0	0	0	
	11	0	0	0	5	
	12	5	10	15	10	Break
	13					
	14					
	15					
	16					
	17					
	18					
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Plant Address

Stack Location 120 yds N

Weather Conditions Clear

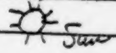
Date 11/8/82

Observer Cray

Observer's Location 2

Wind

HR	MIN	TIME SECONDS 00	15	30	45	COMMENTS
	00					
	01					
	02					Brush
	03					
348 14	04	/	/	/	5	Interference from east monitor @ blower
	05	5	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	5	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	0	5	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	Smoke from West Monitor (:15)
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
	29	0	0	0	0	



RECORD OF VISIBLE EMISSIONS

1.

Company Name Tokyo Steel

Plant Address

Stack Location 120 yd N

Weather Conditions Clear

Date 11/8/82

Observer Coy

Observer's Location 2

Wind-N 5MPH

374

HR	MIN	00	15	30	45	COMMENTS
14	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	5	5	5	5	
	38	5	5	10	15	
	39	20	20	/	/	Interference plume travelling toward
	40	/	/	/	/	observers.
	41	5	0	5	10	
	42	10	10	15	/	
	43	/	/	/	/	Interference plume blowing toward observer
	44	25	30	/	/	Heavy discharge from east monitor
	45	/	/	/	/	
	46	/	/	/	/	
	47	/	0	0	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54					
	55					
	56					
	57					
	58					
	59					

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Plant Address

Stack Location 120 yd NE

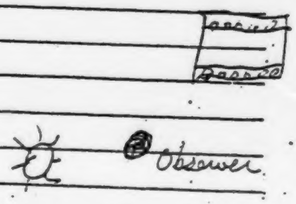
Weather Conditions Clear

Date 11/8/82

Observer Coy

Observer's Location 3

Wind - N - 5MPH



HR	MIN	TIME SECONDS 00	15	30	45	COMMENTS
15	00					
	01					
	02					
	03					
	04					
	05					
	06					
	07					
	08					
	09					
	10					
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					Break
15	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	0	0	
	23	5	5	5	5	
	24	5	5	10	10	
	25	10	5	5	10	
	26	10	5	5	5	
	27	5	0	0	0	Smoke out aset monitor
	28	5	0	0	0	
433	29	0	0	0	0	

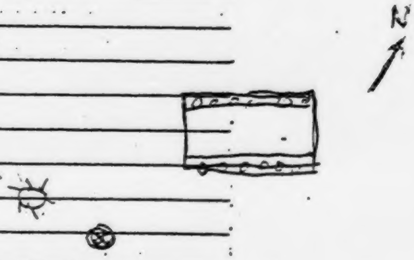
RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Plant Address
Stack Location 120yds NE
Weather Conditions Clear

Date 11/8/82
Observer Coy
Observer's Location 3

COMMENTS Wind—N 5MPH

TIME HR	MIN	SECONDS 00	15	30	45
15	30	0	0	0	0
	31	0	0	0	0
	32	0	0	5	5
	33	5	5	5	5
	34	10	5	5	5
	35	5	5	5	5
	36	5	0	0	0
	37	0	0	5	5
	38	5	5	5	5
	39	5	5	10	10
	40	5	10	5	5
	41	5	5	0	0
	42	0	5	5	0
	43	0	0	0	0
	44	0	0	0	5
	45	5	5	5	5
	46	5	5	5	5
	47	0	5	0	0
	48	5	0	0	0
	49	0	0	0	0
	50	0	0	0	0
	51	0	0	0	0
	52	5	5	0	0
	53	0	0	0	0
	54	0	0	0	0
	55	0	0	0	0
	56	0	0	0	0
	57	0	0	0	0
	58	0	0	0	0
	59	0	0	0	0



RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Plant Address

Stack Location 120 yds NE

Weather Conditions Clear

Date 11/8/82

Observer Coy

Observer's Location 3

TIME						
HR	MIN	SECONDS				COMMENTS
		00	15	30	45	
16	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	5	
	05	5	0	5	5	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	0	0	0	
474	10	0	0	0	0	
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Plant Address Hachinohe Japan
Stack Location
Weather Conditions Wind 0-3 scattered ~~[illegible]~~
Date 11-8.82
Observer MRB
Observer's Location 1
Background. bluesky

8:08

VE 28

TIME						COMMENTS
HR	MIN	SECONDS 00	15	30	45	
	00					
	01					
	02					
	03					
	04					
	05					
	06					
	07					
	08					
	09					
	10					
	11					
	12					
	13					
	14					
	15					
	16					Start 11-8-82
8	17	0	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	5	0	0	
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	5	
	26	0	0	0	0	
	27	5	5	5	5	
	28	10	5	5	5	
	29	5	10	5	10	

RECORD OF VISIBLE EMISSIONS

(2)

Company Name Tokyo Steel

Date 11-8-82

Plant Address

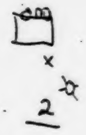
Observer MRB

Stack Location

Observer's Location 1/2

Weather Conditions Wind 0-3 NW ~~Partly cloudy~~ Scattered clouds

Background: ESP structure



TIME						
HR	MIN	SECONDS				COMMENTS
		00	15	30	45	
8	30	15	15	10	10	
	31					Interference; moved to position 2
	32					
8	33	5	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	5	5	5	5	
	38	10	5	5	5	
	39	5	10	5	10	
	40	15	10	5	5	
	41	5	5	5	10	
	42	5	5	5	5	
	43	5	5	5	5	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	5	
	52	5	5	5	5	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
43	59	10	0	0	0	

③

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Date 11-8-82
Plant Address Hachinohe, Japan
Observer MRB
Stack Location
Observer's Location 2
Weather Conditions Wind 0-3 NW
Scattered clouds Background ESP structure

HR	MIN	SECONDS 00	15	30	45	COMMENTS
9	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	5	
	03	0	5	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	5	
	14	0	0	0	0	
	15	0	0	5	5	
60	16	5	5	10	5	
	17					Break
	18					↓
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					

(4)

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Date 11-8-82

Plant Address Hachinohe, Japan

Observer MRB

Stack Location

Observer's Location 2

Weather Conditions scattered/ light NW (0-3)
background = ESP structure

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
	30					Break
	31					
	32					
	33					
	34					↓
98	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	5	
	43	5	5	0	5	
	44	5	5	5	0	
	45	0	0	0	0	
	46	0	5	5	5	
	47	0	0	0	0	
	48	0	10	15	15	
	49	10	10	5	10	
	50	10	10	15	15	
	51	15	15	15	15	
	52	10	10	10	10	
	53	10	15	10	\	interference
	54	\	\	\	\	"
	55	5	5	5	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
103	59	0	0	0	0	

⑤

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Date 11-8-82
Plant Address Hachinohe Japan
Observer MKB
Stack Location
Observer's Location 2
Weather Conditions Scattered clouds
Wind light 0-3

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
10	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	5	5	0	0	
	08	0	5	5	5	
	09	5	10	10	10	
	10	15	10	10	5	
	11	5	5	5	5	
	12	5	5	5	5	
	13	5	5	5	5	
	14	5	5	5	5	
	15	0	0	0	0	
	16	0	0	0	0	
	17	5	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	5	0	0	5	
	22	5	0	5	5	
	23	5	5	5	5	
	24	5	5	5	5	
	25	5	5	5	5	
	26	5	5	10	10	
	27	5	5	5	5	
	28	5	5	5	5	
133	29	5	5	0	0	

⑥

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Date 11-8-82

Plant Address Hachinohe, Japan

Observer MRB

Stack Location

Observer's Location 2

Weather Conditions scattered clouds Wind light NE (0-5)

		TIME				COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
11	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	5	5	
	22	0	0	0	0	
	23	0	0	5	5	
	24	5	5	10	╲	Some from E roof monitor
	25	5	5	5	5	
	26	5	10	5	10	
	27	10	15	20	20	
	28	20	15	╲	╲	interference
193	29	10	5	0	0	

Company Name Tokyo Steel

Plant Address Hachinohe Japan

Stack Location

Weather Conditions Scattered NE light (0-5)

Date 11-8-82

Observer MRB

Observer's Location 2

background: white sky

⑦

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
11	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	5	5	
	44	5	5	5	5	
	45	0	0	0	5	
	46	5	5	5	5	
	47	5	5	5	5	
	48	5	5	5	5	
	49	5	5	5	5	
	50	5	5	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	5	0	
	55	5	5	5	5	
	56	5	5	10	5	
	57	5	10	10	10	
	58	10	10	10	10	
223	59	15	15	15	10	

⑧

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Date 11-8-82
Plant Address
Observer MPB
Stack Location
Observer's Location 2
Weather Conditions Scattered NE light

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
12	00	10	5	5	5	
	01	5	5	0	0	
	02	0	0	0	0	
	03					Lunch
	04					
	05					
	06					
	07					
	08					
	09					
	10					
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					

⑨

RECORD OF VISIBLE EMISSIONS

Company Name Tokyu Steel
Date 11-8-82
Plant Address Hachinohe, Japan
Observer MRB
Stack Location
Observer's Location 2
Weather Conditions Scattered clouds Wind Light NE

HR	MIN	00	15	30	45	COMMENTS
	30					Lunch
	31					
	32					
	33					
	34					
	35					
	36					
261 12	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	5	5	5	
	47	5	5	0	0	
	48	5	5	5	5	
	49	0	5	0	0	
	50	0	5	0	0	
	51	0	0	0	0	
	52	5	5	0	0	
	53	5	5	5	10	
	54	5	5			Wind interference
	55	10	10	5		
	56			5	5	
	57	5	5	5	5	
	58	10	10	~~5~~	~~5~~	"
	59	10	5	5	5	

⑩

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Plant Address Hachinoe, Japan
Stack Location
Weather Conditions clear Wind light NE

Date 11-8-82
Observer MRB
Observer's Location 2
background = blue sky

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
13	00	5	5	5	5	
	01	5	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	5	5	5	
	10	0	0	0	0	
	11	0	0	0	5	
	12	5	10	10	5	
	13	5	5	5	0	
	14	5	5	5	10	
	15	10	10	10	15	
	16	10	5	5	5	
	17	5	5	5	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	0	5	10	
	24	10	10	10	10	
	25	10	10	10	10	
	26	10	5	5	5	
	27	5	10	10	10	
	28	10	5	5	0	
13	29	0	0	0	0	

⑪

Company Name Tokyo Steel
Date 11-8-82
Plant Address Hachinohe, Japan
Observer MRB
Stack Location
Observer's Location 2
Weather Conditions Clear Light wind (0-5) NE

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
13	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	5	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	5	5	5	
	58	0	0	0	0	
343	59	0	0	0	0	

⑫

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Plant Address Hachinohe, Japan
Stack Location
Weather Conditions Clear Wind light NE

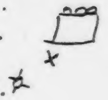
Date 11-8-82
Observer MRB
Observer's Location 2
background = blue sky

TIME						COMMENTS
HR	MIN	SECONDS 00	15	30	45	
14	00	0	0	5	5	
	01	5	5	5	5	
	02	5	/	/	/	interference
	03	5	5	6	/	
	04					Break
	05					
	06					
	07					
	08					
	09					
	10					
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
	19					
	20					
	21					
	22					
	23					
368. 14	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
	29	0	0	0	0	B-120

(13)

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Plant Address Hachinohe, Japan
Stack Location
Weather Conditions clear wind light NE
Date 11-8-82
Observer MRB
Observer's Location 2



TIME

HR	MIN	SECONDS				COMMENTS
		00	15	30	45	
14	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	5	5	5	5	
	38	0	5	5	10	
	39	15	20	20	[illegible]	interference; other plume mixing in
	40	15	15	15	10	
	41	5	5	/	5	″
	42	10	10	10	10	
	43	10	10	10	10	
	44	20	20	[illegible]	/	windy, causing interference from monitor, other
	45	/	/	/	/	side of roof, multiple plumes mixing
	46	/	/	/	/	
	47	/	/	0	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	5	0	0	
403	59	5	0	0	5	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Plant Address Hachinohe, Japan
Stack Location
Weather Conditions clear, light wind [illegible]

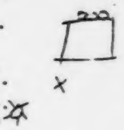
Date 11-8-82
Observer MRB
Observer's Location 2/3

HR	MIN	TIME SECONDS 00	15	30	45	COMMENTS
15	00	5	0	0	0	
	01	5	5	5	10	
	02	10	15	20	/	
	03	15	10	10	10	
	04	5	5	5	5	
	05	5	5	5	5	
	06	5	5	5	5	
	07	5	5	5	5	
	08	5	10	10	10	
	09	5	5	5	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	5	5	5	5	
	14	5	5	5	5	
	15	5	5	0	0	
	16	0	0	0	5	
	17	5	5	5	5	Move to Position 3
422	18	5	5	5	5	
	19					Break ↓
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					

RECORD OF VISIBLE EMISSIONS

(15)

Company Name Tokyo Steel
Date 11-8-82
Plant Address Hachinohe, Japan
Observer MRB
Stack Location
Observer's Location 3
Weather Conditions Clear NNE light (0.5) Background: blue sky



TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
	30					Break
	31					
	32					
	33					
	34					
	35					
	36					
	37					
15	38	5	5	5	5	
	39	5	5	10	10	
	40	10	10	5	5	
	41	5	5	0	0	
	42	0	5	5	0	
	43	0	0	0	0	
	44	0	0	5	5	
	45	0	5	5	5	
	46	5	5	5	5	
	47	5	5	5	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	5	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
463	59	0	0	0	0	

(16)

RECORD OF VISIBLE EMISSIONS

Company Name Tokyu Steel
Date 11-8-82
Plant Address Hachinde, Japan
Observer MRB
Stack Location
Observer's Location 3
Weather Conditions Clear light (0-5) wind NE
backgrounds sky

HR	MIN	SECONDS 00	15	30	45	COMMENTS
16	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
VE 28	09	0	0	0	0	
414	10	0	0	0	0	
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					

RECORD OF VISIBLE EMISSIONS

Company Name
Date 11/8/02
Plant Address
Observer
Stack Location
Observer's Location 2
Weather Conditions ptly cldy - light wind

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
8	30					
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					
	41					
	42					
	43					
	44					
	45					
	46					
	47					
	48					
VE18	49					start
54	50	0	0	0	0	
	51	0	0	0	0	
	52	0	5	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name
Plant Address
Stack Location
Weather Conditions ——

Date 11/8/82
Observer L. Goldman
Observer's Location 2

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
9	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	5	
VE18 60	16	5	5	5	5	
VE18 61	17	5	5	5	5	
	18	5	5	5	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	5	0	5	
	22	0	0	0	0	
	23	0	0	0	0	
	24	0	0	0	0	
	25	5	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name ____________________
Plant Address ____________________
Stack Location ____________________
Weather Conditions ____________________

Date 12/8/82
Observer L. Goldman
Observer's Location 2

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
9	30	0	0	0	0	
	31	0	0	0	0	monitor emissions - East side
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35					Break
	36					
	37					
	38					
	39					
	40					
	41					
	42					
	43					
	44					
	45					
	46					
	47					
	48					
	49					
	50					
	51					
	52					
	53					
	54					
	55					
	56					
	57					
	58					
	59					

RECORD OF VISIBLE EMISSIONS

Company Name

Plant Address

Stack Location

Weather Conditions

Date 11/8/82

Observer L. Oldman

Observer's Location 2

VE18

104

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
10	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	5	5	5	
	09	5	10	10	10	
	10	10	5	5	5	
	11	5	5	5	0	
	12	0	5	5	0	
	13	0	5	5	5	
	14	5	5	5	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	5	5	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	5	5	0	5	
	22	0	0	0	5	
	23	5	5	5	5	
	24	5	5	5	5	
	25	5	0	5	5	
	26	5	5	5	5	
	27	5	5	5	5	
	28	5	5	5	5	
	29	5	5	0	5	

133

RECORD OF VISIBLE EMISSIONS

Company Name
Plant Address
Stack Location
Weather Conditions

Date 11/8/82
Observer L. Colfun
Observer's Location 2

VE 28

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
134 10	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	5	5	
	36	0	5	5	5	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	5	5	5	10	
	49	10	10	10	10	
	50	5	10	10	5	
	51	5	5	5	10	
	52	5	5	5	5	
	53	5	5	5	0	
	54	0	0	0	0	background smokey (from roof monitor?) - light grey-white
	55	0	0	0	0	
	56	0	0	5	0	
	57	0	0	0	0	
	58	0	0	0	0	
163	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

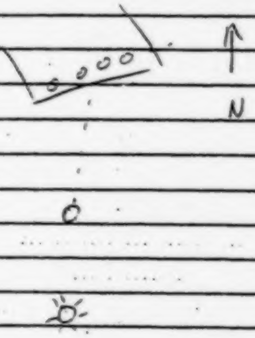
Company Name ______________________ Date 11/8/82

Plant Address ______________________ Observer L. Goldman

Stack Location ______________________ Observer's Location 2

Weather Conditions ______________________

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
11	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	5	5	0	0	
	45	0	0	0	5	
	46	5	5	0	5	
	47	5	10	5	5	
	48	0	5	0	5	
	49	5	5	5	5	
	50	5	5	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	5	
	55	5	5	5	5	
	56	5	5	10	5	
	57	5	5	5	5	
	58	5	5	10	10	
223	59	10	10	10	10	



RECORD OF VISIBLE EMISSIONS

Company Name
Date 11/8/82
Plant Address
Observer L. Coffman
Stack Location
Observer's Location 2
Weather Conditions

HR	MIN	TIME SECONDS 00	15	30	45	COMMENTS
12	00	5	5	0	5	
VE18	01	5	0	0	0	
226	~~02~~	0	0	0	0	
VE 28 227	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	5	5	5	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	5	5	0	0	
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	5	0	
	27	5	0	0	0	background smoke from monitors
	28	0	X	X	0	
253	29	/	/	/	0	

RECORD OF VISIBLE EMISSIONS

Company Name
Plant Address
Stack Location
Weather Conditions clear - light wind
Date 11/8/82
Observer L. Goldman
Observer's Location #2

TIME						
HR	MIN	SECONDS				COMMENTS
		00	15	30	45	
IE28 254 12-14 DW50	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	5	5	
	33	X	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37					
	38					
	39					
	40					
	41					
	42					
	43					
	44					
	45					
	46					
	47					
	48					
	49					
	50					
	51					
	52					
	53					
	54					
	55					
	56					
	57					
	58					
	59					

RECORD OF VISIBLE EMISSIONS

Company Name

Plant Address

Stack Location

Weather Conditions

Date Nov 8, 1982

Observer WL Klotz

Observer's Location 2

VE18
297

HR	MIN	00	15	30	45	COMMENTS
	00					
	01					
	02					
	03					
	04					
	05					
	06					
	07					
	08					
	09					
	10					
	11					
	12					
13	13	5	5	0	0	
	14	5	5	5	10	
	15	10	10	10	10	
	16	10	5	5	5	
	17	5	5	5	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	0	0	10	
	24	10	10	10	10	
	25	15	10	5	5	
	26	10	10	5	5	
	27	10	10	10	10	
	28	5	5	5	5	
	29	0	0	0	0	

Company Name ______________________

Plant Address ______________________

Stack Location ______________________

Weather Conditions clear

Date Nov 8, 1982

Observer WJ Kbby

Observer's Location 2

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
-13	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	5	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	5	0	
	58	0	0	0	0	
343	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name
Plant Address
Stack Location
Weather Conditions clear
Date Nov8, 1982
Observer W2 Klos
Observer's Location 2

HR	MIN	TIME SECONDS 00	15	30	45	COMMENTS
14	00	0	0	0	5	
	01	5	5	5	5	
VE18	02	5	5	5	5	
347	03	5	0	5	5	— Break
VE23 348	04	0	/	/	0	~~[illegible]~~
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	0	5	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	0	0	0	— Break
	24					
	25					
	26					
	27					
	28					
	29					

Company Name Tokyo Steel
Date Nov 8, 1982
Plant Address Hachinohe
Observer W L Klotz
Stack Location
Observer's Location 2
Weather Conditions Clear, wind 0-5 mph SW

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
	30					
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					
	41					
	42					
	43					
	44					
	45					
	46					
	47					
	48					
	49					
	50					
	51					
	52					
VE18	53					
398 14	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	5	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo steel

Date Nov 8, 1982

Plant Address Hachinohe

Observer W. Klotz

Stack Location

Observer's Location 2

Weather Conditions clear - wind 0-5 mph N

TIME						
HR	MIN	SECONDS 00	15	30	45	COMMENTS
15	00	5	0	0	0	
	01	5	5	5	10	
	02	5	15	20	15	
	03	10	10	10	5	
	04	5	5	5	5	
	05	5	0	0	0	
	06	5	5	5	5	
	07	5	5	0	0	
	08	5	10	10	5	
	09	5	5	5	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	5	5	5	5	
	14	5	5	5	5	
	15	5	5	5	5	
	16	5	5	5	5	
	17'	5	5	5	0	
422	18	0	0	0	0	
VE28 423	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	0	0	5	
	24	5	5	5	5	
	25	0	5	5	5	
	26	0	5	5	5	
	27	5	0	0	0	
	28	0	0	0	5	
	29	0	0	0	0	

Company Name ______

Plant Address ______

Stack Location ______

Weather Conditions ______

Date NOV 8, 1982

Observer WLKlotz

Observer's Location 2

TIME						
HR	MIN	SECONDS				COMMENTS
		00	15	30	45	
5	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	5	5	5	5	
	34	5	5	5	5	
	35	5	5	5	5	
	36	5	0	0	0	
	37	0	0	0	0	— break
	38					
	39					
	40					
	41					
	42					
	43					
	44					
	45					
	46					
	47					
	48					
	49					
	50					
	51					
	52					
	53					
	54					
	55					
	56					
	57					
	58					
	59					

SUMMARY
RECORD OF VISIBLE EMISSIONS

Type of Plant EAF

Date 11/9/82

Company Name Tokyo Steel

Hours of Observation ________

Plant Address Hachinhoe. Japan

Observer ________

Type of Discharge STACK OTHER 15 stub-stacks

Discharge Location Roof mounted ESP

Height of Point of Discharge 40 m

Observer's Location:

Distance to Discharge Point 140 yds

Height of Observation Point gnd level

Direction from Discharge Point South

Background Description Broken Clouds & ESP sidewall

Weather: Clear Overcast [✓ Partly Cloudy] Other ________ Color ________

Wind Direction West → East Wind Velocity 0-5 mi/hr

Plume Description:

Detached: Yes No

Color: Black White Other ________

Plume Dispersion Behavior: Looping Coning [✓ Fanning?] Lofting Fumigating Other ________

Estimated Distance Plume Visible ________

Summary of Observations:

Opacity	Aggregate Time @ Opacity min.	sec.	Opacity	Aggregate Time @ Opacity
0			55	
5			60	
10			65	
15			70	
20			75	
25			80	
30			85	
35			90	
40			95	
45			100	
50				

RECORD OF VISIBLE EMISSIONS

Company Name ____________

Date 11/9/82

Plant Address ____________

Observer L. Goldman

Stack Location ____________

Observer's Location #2

Weather Conditions ____________

HR	MIN	SECONDS 00	15	30	45	COMMENTS
08	00					
	01					
	02					
	03					
	04					
	05					
	06					
	07					
	08					
	09					
	10					
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
VE 29	19					
08	20				0	start
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	5	
	27	5	5	5	5	
	28	5	10	5	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name ____________

Plant Address ____________

Stack Location ____________

Weather Conditions ____________

Date 11/9/82

Observer L. Goldman

Observer's Location 2

HR	MIN	00	15	30	45	COMMENTS
08	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	5	5	
	34	5	5	5	5	
	35	5	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	west monitor - light emissions
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name
Plant Address
Stack Location
Weather Conditions
Date 11/9/82
Observer
Observer's Location

HR	MIN	SECONDS 00	15	30	45	COMMENTS
09	00	0	0	0	0	
	01	0	0	0	5	
	02	0	0	0	0	
	03	0	5	5	0	
	04	5	0	5	5	
	05	0	0	5	0	
	06	0	0	0	5	
	07	0	0	/	0	Slight vent monitor fume
	08	5	0	5	0	
	09	0	0	0	0	
	10	0	0	5	0	
	11	0	0	0	0	
	12	0	0	0	0	has become mostly cloudy
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
51	16	0	0	0	0	
	17					
	18					
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					

RECORD OF VISIBLE EMISSIONS

Company Name

Plant Address

Stack Location

Weather Conditions

Date 11/9/42

Observer L. Golfman

Observer's Location 2

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
09	30					
	31					
	32					
	33					
	34					
	35					
	36	0	5	5	5	
	37	5	5	5	5	
	38	5	10	5	5	
	39	5	5	5	10	
	40	5	5	5	5	
	41	5	5	5	5	
	42	5	5	5	5	
	43	5	6	5	5	
	44	0	5	5	5	
	45	5	5	5	5	
	46	5	5	0	5	
	47	0	0	0	0	
	48	0	5	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	5	0	0	
	52	5	5	5	0	
	53	0	5	5	0	
	54	5	0	0	5	
	55	5	0	5	0	
	56	0	0	0	5	
	57	5	5	5	5	
	58	5	0	0	0	
100	59	5	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name ____________

Plant Address ____________

Stack Location ____________

Weather Conditions ____________

Date 11/9/92

Observer L. Golyfman

Observer's Location 2

TIME						
HR	MIN	SECONDS				COMMENTS
		00	15	30	45	
10	00	0	5	5	0	occassional WISPS from ESP
	01	0	0	0	0	
	02	0	0	5	5	
	03	5	5	5	5	
	04	5	5	5	5	
	05	5	10	10	5	
	06	5	5	5	5	
	07	5	5	5	5	
	08	5	0	0	0	completly overcast
	09	0	0	0	0	
	10	0	0	0	5	
	11	10	10	10	5	
	12	10	10	5	5	
	13	5	5	5	5	
	14	5	5	5	0	
	15	5	0	0	0	
	16	0	0	0	0	
	17	0	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	0	5	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
130	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name

Plant Address

Stack Location

Weather Conditions Overcast -cloudy

Date 11/9/82

Observer L. [illegible]

Observer's Location 2

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
10	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34					Break
	35					
	36					
	37					
	38					
	39					
	40					
	41					
	42					
	43					
	44					
	45					
	46					
	47					
	48					
	49					
	50					
	51					
	52					
	53					
	54					
	55					
	56					
	57					
	58					
	59					

RECORD OF VISIBLE EMISSIONS

Company Name ____

Plant Address ____

Stack Location ____

Weather Conditions Cloudy

Date 11/9/92

Observer L. Golfman

Observer's Location 2

HR	MIN	SECONDS 00	15	30	45	COMMENTS
11	00					
	01					start
163	02	0	0	0	0	
	03	0	5	5	5	
	04	0	0	0	0	
	05	0	5	5	5	
	06	10	10	15	10	
	07	10	5	5	5	
	08	5	5	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	5	0	5	
	12	0	0	0	0	
	13	0	0	0	5	
	14	5	0	5	5	
	15	0	0	5	5	
	16	5	0	5	0	
	17	0	0	5	5	
	18	5	0	0	0	
	19	0	0	0	0	
	20	0	0	0	5	
	21	5	5	5	0	
	22	0	0	0	0	
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name ____________

Plant Address ____________

Stack Location ____________

Weather Conditions Overcast

Date 11/9/81

Observer L. Golfman

Observer's Location 2

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
II	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	5	5	5 ~~0~~	5	
	36	5	5	5	5	
	37	5	5	5	0	
	38	0	0	0	0	
	39	0	5	0	0	
	40	0	0	5	5	
	41	5	5	5	5	
	42	5	5	0	5	
	43	0	0	0	5	
	44	5	5	5	5	
	45	5	5	0	0	
	46	5	5	5	5	
	47	5	0	0	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
220	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name

Plant Address

Stack Location

Weather Conditions overcast

Date 11/9/82

Observer L. Gohfman

Observer's Location 2

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
12	30					
	31					
	32					Start
254	33	0	0	5	5	
	34	5	5	5	10	
	35	10	5	5	5	
	36	5	0	5	5	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	5	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	5	5	
	49	5	5	5	5	
	50	5	5	5	5	
	51	5	5	5	5	
	52	5	5	5	5	
	53	5	5	5	5	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name
Plant Address
Stack Location
Weather Conditions

Date 11/9/82
Observer L. Goldman
Observer's Location 2

281

HR	MIN	SECONDS 00	15	30	45	COMMENTS
13	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	/	
	17					
	18					
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26				-	
	27					
	28					
	29					

RECORD OF VISIBLE EMISSIONS

Company Name
Date 11/9/82
Plant Address
Observer L. Coleman
Stack Location
Observer's Location 2
Weather Conditions broken - wind from east at 0-5

TIME HR	MIN	SECONDS 00	15	30	45	COMMENTS
-13	30					
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					
	41					
323	42	0	0	0	0	
	43	0	0	0	0	
	44	5	10	5	5	
	45	5	5	5	5	
?—	46	5	5	10	10	down wash - wind reversed - now Easterly
	47	10	10	15	15	Interference ~~E—W~~
	48	15	20	20	/	from roof monitor - east end
	49	/	/	/	/	
	50	/	/	/	5	
	51	5	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	5	0	0	
	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name ______________________ Date 11/9/81

Plant Address ______________________ Observer L. Colfman

Stack Location ______________________ Observer's Location 2

Weather Conditions broken 0-5 wind - from east

HR	MIN	TIME SECONDS 00	15	30	45	COMMENTS
14	00	0	0	0	0	
	01	0	0	0	0	
	02	0	/	0	0	monitor emission - slight
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	5	10	5	
	07	5	0	5	5	
	08	5	5	5	10	
	09	10	15	15	15	
	10	10	/	/	/	roof monitor interference
	11	/	10	10	5	
	12	5	5	5	10	
	13	5	5	5	5	
	14	5	5	5	10	
	15	10	10	10	10	
	16	10	15	20	25	
	17	20	20	25	20	
	18	15	20	15	15	
	19	10	15	20	25	
	20	15	20	10	10	
	21	10	5	10	20	
	22	20	25	20	15	
	23	15	20	20	15	
	24	20	20	15	5	
	25	5	10	10	10	
	26	10	5	5	5	
	27	/	/	/	/	monitor interference
	28	5	/	/	5	
310	29	5	5	5	5	

RECORD OF VISIBLE EMISSIONS

Company Name
Plant Address
Stack Location
Weather Conditions broken clouds

Date 11/9/82
Observer L. Gohlfman
Observer's Location 2

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
15	00					
	01					
	02					Start
	03	0	0	/	/	Truck dust
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	/	0	0	truck dust
	23	0	0	0	0	
	24	5	10	10	10	
	25	10	10	10	10	down drafting
	26	10	10	10	10	
	27	10	5	5	5	
	28	5	5	5	5	
430	29	5	5	5	5	

RECORD OF VISIBLE EMISSIONS

Company Name ____________________

Plant Address ____________________

Stack Location ____________________

Weather Conditions ____________________

Date 11/9/22

Observer L. Colfman

Observer's Location 3

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
15	30	5				
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	5	5	
	43	0	0	0	5	
	44	10	5	5	5	
	45	5	5	10	10	
	46	5	5	5	5	
	47	5	0	0	0	
	48	0	5	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	5	5	
	53	5	10	10	5	
	54	5	5	5	10	Sun going down
	55	10	15	10	10	
	56	10	10	5	5	
	57	5	5	5	10	
	58	10	10	10	5	
46	59	5	5	5	5	

RECORD OF VISIBLE EMISSIONS

Company Name ______

Plant Address ______

Stack Location ______

Weather Conditions ______

Date 11/9/82

Observer ______

Observer's Location 3

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
16	00	5	5	5	5	
42	01	5	5	0	0	
	02					
	03					
	04					
	05					
	06					
	07					
	08					
	09					
	10					
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo steel
Plant Address
Stack Location
Weather Conditions
Date Nov 9, 1982
Observer WLKlotz
Observer's Location 2

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
8	00					
	01					
	02					
	03					
	04					
	05					
	06					
	07					
	08					
	09					
	10					
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
	19					Start
VE17 1	20	/	0	0	0	walking to position
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	0	
	27	5	5	5	5	
	28	5	5	5	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name ______

Plant Address ______

Stack Location ______

Weather Conditions overcast

Date Nov 9, 1982

Observer WLKlotz

Observer's Location 2

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
8	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	5	5	
	34	5	5	5	5	
	35	5	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	0	0	0	0	
	45	0	0	0	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name ______

Plant Address ______

Stack Location ______

Weather Conditions overcast (broken) wind 0-5 mph SW

Date Nov 9 1982

Observer W L Klotz

Observer's Location 2

HR	MIN	00	15	30	45	COMMENTS
		TIME				
		SECONDS				
9	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	5	5	0	
	04	0	0	0	5	
	05	0	5	0	5	
	06	0	0	0	0	
	07	0	0	0	0	
	08	5	5	5	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	0	
	16	0	0	0	0	
	17	0	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	0	0	0	
	24	0	0	0	0	
	25	5	5	5	5	
	26	5	10	5	/	roof monitor
	27	0	0	/	/	roof monitor
	28	0	0	0	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name

Plant Address

Stack Location

Weather Conditions Broken

Date Nov 9, 1982

Observer W L Klotz

Observer's Location 2

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
9	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	5	
	33	0	0	0	0	
	34	0	0	5	0	
76	35	5	0	0	5	Break —
	36					
	37					
	38					
	39					
	40					
	41					
	42					
	43					
	44					
	45					
	46					
	47					
	48					
	49					
	50					
	51					
	52					
	53					
	54					
	55					
	56					
	57					
	58					
	59					

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Plant Address
Stack Location
Weather Conditions broken
Date Nov 9, 1982
Observer W L Kloth
Observer's Location 2

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
	00					
	01					
	02					
	03					
	04					
	05					
	06					
	07					
	08					
	09					
11 10	10	0	0	5	5	
	11	5	5	5	5	
	12	5	5	5	5	
	13	5	5	5	5	
	14	5	10	5	5	
	15	5	5	5	5	
	16	0	0	0	0	
	17	0	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Date Nov 9, 1982

Plant Address

Observer WL Klotz

Stack Location

Observer's Location 2

Weather Conditions broken, wind 0-5mph SW

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
10	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	5	5	5	5	
	45	5	5	5	5	
	46	10	5	10	5	
	47	5	5	5	5	
	48	5	5	5	5	
	49	5	5	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Date Nov 9 1982
Plant Address
Observer L.K. Klotz
Stack Location
Observer's Location 2
Weather Conditions overcast

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
11	00	0	0	0	0	
	01	0	0	0	0	
	02					
	03					
	04					
	05					
	06					
	07					
	08					
	09					
	10					
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					

RECORD OF VISIBLE EMISSIONS

Company Name William L Klotz

Plant Address

Stack Location

Weather Conditions broken

Date Nov 9, 19

Observer WL Klotz

Observer's Location 2

TIME						
HR	MIN	SECONDS				COMMENTS
		00	15	30	45	
11	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	5	
	35	5	5	5	5	
	36	5	5	5	0	
	37	0	5	5	0	
	38	0	0	0	0	
	39	5	5	0	0	
	40	0	0	0	0	
	41	5	5	5	5	
	42	5	5	5	5	
	43	5	5	0	5	
	44	5	5	5	5	
	45	5	5	5	5	
	46	5	5	5	5	
	47	5	0	5	5	
	48	0	0	0	0	
	49	5	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	5	0	
	57	0	0	0	0	
	58	0	0	0	0	
220	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Date Nov 9, 1982

Plant Address

Observer WL Klotz

Stack Location

Observer's Location 2

Weather Conditions overcast

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
12	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	5	5	5	
	14	5	5	5	10	
	15	10	10	10	5	
	16	5	5	10	10	
	17	5	5	10	10	
	18	5	5	5	5	
	19	5	5	5	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
250	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name ____________

Plant Address ____________

Stack Location ____________

Weather Conditions overcast

Date Ma 9, 1982

Observer WLKlotz

Observer's Location 2

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
12	30	0	0	0	0	
	31	0	0	5	5	
258	32	0	0	0	0	
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					
	41					
	42					
	43					
	44					
	45					
	46					
	47					
	48					
	49					
	50					
	51					
	52					
	53					
	54					
	55					
	56					
	57					
	58					
	59					

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Date Nov 9, 1982

Plant Address Hachinohe, Japan

Observer

Stack Location

Observer's Location Position 2

Weather Conditions

TIME						
HR	MIN	SECONDS				COMMENTS
		00	15	30	45	
	00					
	01					
	02					
	03					
	04					
	05					
	06					
	07					
	08					
	09					
	10					
	11					
	12					
	13					
	14					
	15					
	16					
298 13	17	0	0	0	0	
13	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	5	5	5	5	
	22	5	5	5	5	
	23	5	5	5	/	truck dust
	24	/	5	/	0	truck dust, [illegible] monitor
	25	0	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name

Plant Address

Stack Location

Weather Conditions broken

Date Nov 9, 198

Observer WLKlotz

Observer's Location 2

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
13	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	5	10	5	5	
	45	5	5	5	10	
	46	5	5	5	10	
	47	10	15	15	15	} roof monitor ? (Taken as interference)
	48	15	20	20	/	}
	49	/	/	/	/	
	50	/	/	10	5	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
340	59	0	0	0	0	

Company Name Tokyo Steel
Plant Address
Stack Location
Weather Conditions clear

Date
Observer NOV 9 1982
WL Kloty
Observer's Location 2

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
371 14	30	5	5	5	5	
	31	5	5	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	5	0	
	42	0	0	0	0	
	43	0	0	0	0	
	44	5	5	0	5	
	45	5	0	5	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	0	5	
	49	5	10	5	10	
	50	10	10	15	10	
	51	10	10	10	/	roof monitor
	52	/	5	10	10	
	53	10	10	10	10	
	54	5	/	5	5	roof monitor
	55	5	5	5	5	
	56	5	10	5	5	
	57	5	5	~~5~~	/	roof monitor
	58	/	/	/	0	
	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Date Nov 9 1982

Plant Address

Observer WLKlotz

Stack Location

Observer's Location 2

Weather Conditions broken

	HR	MIN	SECONDS 00	15	30	45	COMMENTS
401	15	00	0	0	0	0	
		01	0	0	0	0	
		02	0	0	0	0	
		03	5	/	/	/	truck dust c̄ roof monitor
		04	0	0	0	0	
		05	0	0	0	0	
		06	0	0	0	0	
		07	0	0	0	0	
		08	0	0	0	0	
		09	0	0	0	0	
		10	0	0	0	0	
		11	0	0	0	0	
		12	0	0	0	0	
		13	0	0	0	0	
		14	0	0	0	0	
		15	0	0	0	0	
		16	0	0	0	0	
		17	0	0	0	0	
		18	0	0	0	0	
		19	0	0	0	0	
		20	0	0	0	0	
		21	0	0	0	0	
		22	0	0	0	0	
		23	0	0	0	0	
		24	5	10	15	15	
		25	15	10	5	5	
		26	5	5	10	10	
		27	5	5	5	5	
		28	5	5	5	5	
430		29	5	5	0	0	[illegible]

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Plant Address
Stack Location
Weather Conditions broken

Date Nov 3, 1982
Observer GC Klotz
Observer's Location #3

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
	00					
	01					
463 16	02	5	5	5	5	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	5	5	
	07	5	5	5	5	
	08	5	5	5	0	
VE 19	09	0	0	0	0	
471	10	0	0	0	0	— end
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Plant Address
Stack Location 120 ud N
Weather Conditions Broken Clouds

Date 11/9/77
Observer Coy
Observer's Location 2
Wind - SW - 3-5 mPH

HR	MIN	SECONDS 00	15	30	45	COMMENTS Start Time 8:07 AM
	00					
	01					
	02					
	03					
	04					
	05					
	06					
	07					
	08					
	09					
	10					
	11					
	12					
	13					
	14					
	15					
	16					
58 09	17	0	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	5	0	0	
	24	0	0	5	5	
	25	5	10	5	10	
	26	10	15	5	5	Smoke out of West monitor of East (20)
	27	0	5	/	0	
	28	5	0	0	0	
	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Plant Address

Stack Location 130 yd N

Weather Conditions Broken Cloud

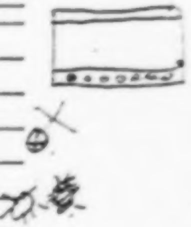
Date 11/9/82

Observer Coy

Observer's Location 2

Wind SW - 2-4 MPH

HR	MIN	00	15	30	45	COMMENTS
09	30	0	0	0	0	
	31	0	0	5	0	
	32	0	5	0	5	
	33	5	0	0	0	
VE29	34	0	5	5	5	
76	35	0	0	5	0	
VEA	36	5	5	0	5	
	37	5	5	5	5	
	38	5	5	5	5	
	39	5	5	10	10	
	40	10	5	10	5	
	41	10	5	10	5	
	42	5	5	5	10	
	43	5	5	5	5	
	44	5	5	5	5	
	45	5	5	5	5	
	46	5	5	5	5	
	47	5	0	0	5	
	48	0	5	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	5	0	0	
	52	5	0	0	0	
	53	0	0	5	0	
	54	5	5	0	5	
	55	5	0	5	0	
	56	0	5	5	5	
	57	0	5	0	5	
	58	5	0	0	5	
100	59	0	0	5	0	



RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Plant Address

Stack Location 120 yds N

Weather Conditions Broken Cloud

Date 11/9/82

Observer Coy

Observer's Location 2

Wind - SW 2-4 MPH

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
10	00	0	5	0	5	
	01	0	0	0	0	
	02	0	5	5	5	
	03	5	5	5	5	
	04	5	5	5	10	
	05	5	5	5	10	
	06	10	5	5	5	
	07	5	5	5	5	
	08	5	0	0	0	
110	09	0	0	0	0	
	10					
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26				–	
	27					
	28					
	29					

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Plant Address

Stack Location 120 yds N

Weather Conditions Overcast

Date 11/9/82

Observer Coy

Observer's Location 2J

Wind SW - 2-4 mPH

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
10	30					
	31					
	32					Break
VE 29	33					
135	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	0	0	Smoke from east monitor (5)
	44	5	5	5	5	
	45	5	5	5	5	
	46	5	5	10	10	
	47	5	5	5	10	
	48	5	5	5	5	
	49	5	5	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	0	0	
	53	0	0	0	0	
	54	0	0	0	0	
	55	0	0	0	0	
	56	0	0	0	0	
	57	0	0	0	0	
	58	0	0	0	0	
	59	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Date 11/9/82

Plant Address

Observer Cay

Stack Location 120 yds N

Observer's Location 21

Weather Conditions Overcast

Wind SW

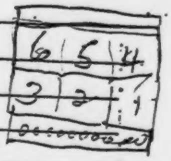
HR	MIN	SECONDS 00	15	30	45	COMMENTS
VE29 11	00	0	0	0	0	
162	01	0	0	0	0	
VE19 163	02	0	0	5	0	
	03	0	5	5	5	
	04	0	0	0	0	
	05	0	5	5	5	
	06	10	10	15	15	
	07	10	5	5	5	
	08	5	5	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	5	5	5	
	12	5	0	0	5	
	13	0	0	5	5	
	14	5	5	0	5	
	15	5	5	5	5	
	16	0	5	0	0	
	17	0	0	5	5	
	18	5	0	0	0	
	19	0	0	0	0	
	20	0	0	0	0	
	21	5	0	0	0	
	22	0	0	0	0	
	23	0	0	0	0	
	24	0	0	0	0	Smoke from east monitor
	25	0	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
190	29	0	0	0	0	

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Plant Address
Stack Location 120 yds N
Weather Conditions Overcast
Date 11/9/82
Observer Coy
Observer's Location 2
Wind SW - 2-4 MPH

VE 2a - 221

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
12	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	5	5	5	
	14	5	5	5	15	
	15	15	10	10	5	
	16	5	5	5	10	
	17	10	5	10	10	Smoke out of west monitor
	18	5	5	5	5	
	19	5	5	0	0	
	20	0	0	0	0	
	21	0	0	0	0	
	22	0	0	0	0	
	23	0	0	0	0	
	24	0	0	0	0	
	25	0	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
	29	0	0	0	0	



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RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Plant Address
Stack Location 120 yds
Weather Conditions Overcast

Date 11/9/82
Observer Coy
Observer's Location 2

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
12	30	0	0	0	0	
	31	0	5	5	5	
253	32	0	0	0	4	
VE 19 254	33	0	0	5	5	Smoke from east Monitor
	34					
	35					
	36					
	37					
	38					
	39					
	40					
	41					
	42					
	43					
	44					
	45					
	46					
	47					
	48					
	49					
	50					
	51					
	52					
	53					
	54					
	55					
	56					
	57					
	58					
	59					

RECORD OF VISIBLE EMISSIONS

①

Company Name Tokyo Steel
Date 11-9-82
Plant Address Hachinohe, Japan
Observer MRB
Stack Location
Observer's Location 2
Weather Conditions Overcast / calm
background - sky

HR	MIN	TIME SECONDS 00	15	30	45	COMMENTS
	30					
	31					
	32					
	33					START
VEA 255 12	34	5	5	5	10	
	35	5	0	5	5	
	36	5	5	0	5	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	0	0	
	43	0	0	5	5	
	44	5	0	0	0	
	45	0	0	0	0	
	46	0	0	5	5	
	47	5	5	0	0	
	48	0	0	5	5	
	49	5	5	5	5	
	50	5	5	5	5	
	51	5	5	5	5	
	52	5	5	5	5	
	53	5	5	5	5	
	54	5	5	0	0	
	55	0	5	0	0	
	56	0	0	0	0	
	57	0	0	0	5	
	58	0	0	0	5	
[illegible]	59	0	0	0	0	

②

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Plant Address Hachinohe, Japan
Stack Location
Weather Conditions overcast / calm
Date 11-9-82
Observer MRB
Observer's Location 2
background: sky

HR	MIN	00	15	30	45	COMMENTS
13	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	0	0	
	07	0	0	0	0	
	08	0	0	0	0	
	09	0	0	0	0	
	10	0	0	0	0	
	11	0	0	0	0	
	12	0	0	0	0	
	13	0	0	0	0	
	14	0	0	0	0	
	15	0	0	0	5	
297	16	5	5	5	5	
VE 29 298	17	0	0	0	0	
	18	0	0	0	0	
	19	0	0	0	0	
	20	0	5	0	5	
	21	5	5	5	5	
	22	5	5	5	5	
	23	5	5	5	5	
	24	5	5	5	0	
	25	5	0	0	0	
	26	0	0	0	0	
	27	0	0	0	0	
	28	0	0	0	0	
	29	0	0	0	0	

③

Company Name Tokyo Steel

Plant Address Hachinohe, Japan

Stack Location

Weather Conditions Scattered clouds

Date 11-9-82

Observer MRB

Observer's Location 2

Wind calm · background = sky

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
13	30	0	0	0	0	
	31	0	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
VE29	40	0	0	0	0	
322	41	0	0	0	0	
	42					Break
	43					
	44					
	45					
	46					
	47					
	48					
	49					
	50					
	51					
	52					
	53					
	54					
	55					
	56					
	57					
	58					
	59					

(4)

RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Plant Address Hachinohe, Japan

Stack Location

Weather Conditions Scattered clouds/calm

Date 11-9-82

Observer MB

Observer's Location 2

VE 9
341

TIME						COMMENTS
HR	MIN	SECONDS				
		00	15	30	45	
14	00	0	0	0	0	
	01	0	0	0	0	
	02	0	0	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	5	5	5	5	
	07	5	0	5	5	
	08	5	10	10	10	
	09	10	10	10	15	
	10	15	/	/	/	interference from roof monitor
	11	/	10	10	10	
	12	10	5	5	5	
	13	5	5	5	5	
	14	5	5	5	10	
	15	10	10	10	10	
	16	15	15	15	20	
	17	20	15	20	20	
	18	15	15	15	10	
	19	15	15	20	20	
	20	20	15	10	15	
	21	15	15	15	20	
	22	20	25	25	15	
	23	15	20	20	20	
	24	20	20	15	15	
	25	10	15	10	10	
	26	5	5	5	10	
	27	~~10~~ /	/	/	/	interference from roof monitor (wind)
	28	5	/	/	5	
	29	5	5	5	5	

VE 19
370

⑤

Company Name Tokyo Steel
Plant Address Hachinohe Japan
Stack Location
Weather Conditions scattered clouds wind calm

Date 11-9-82
Observer MRB
Observer's Location 2
background - sky

TIME						COMMENTS
HR	MIN	SECONDS				
1629		00	15	30	45	
371-14	30	5	5	5	5	
	31	5	0	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	5	
	40	0	0	0	0	
	41	0	0	5	5	
	42	5	0	0	0	
	43	0	0	0	0	
	44	5	5	5	5	
	45	5	5	5	0	
	46	0	0	0	0	
	47	0	0	0	0	
	48	0	0	0	5	
	49	5	5	5	10	
	50	10	10	10	10	
	51	10	10	10	/	interference swirling & roof monitor
	52	/	/	5	10	
	53	10	15	10	5	
	54	5	/	5	5	
	55	5	5	5	5	
	56	10	15	10	5	
	57	10	5	0	/	- interference roof monitor
	58	/	/	/	0	
	59	0	0	0	0	

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RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel
Plant Address Hachinoh, Japan
Stack Location
Weather Conditions Scattered clouds. wind light
Date 11-9-82.
Observer MEB
Observer's Location 2
background - sky

TIME						
HR	MIN	SECONDS				COMMENTS
		00	15	30	45	
15	00	0	0	0	0	
VE 29	01	0	0	0	0	
4o3	02	0	5	5	5	
	03					Break
	04					
	05					
	06					
	07					
	08					
	09					
	10					
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					

⑦

Company Name Tokyo Steel

Plant Address Hachinohe, Japan

Stack Location

Weather Conditions scattered clouds
Wind - light

Date 11-9-82

Observer WRB

Observer's Location 3

VE19
431

TIME HR	MIN	SECONDS 00	15	30	45	COMMENTS
15	30	5	/	/	/	interference from roof monitor
	31	0	5	0	0	
	32	0	0	0	0	
	33	0	0	0	0	
	34	0	0	0	0	
	35	0	0	0	0	
	36	0	0	0	0	
	37	0	0	0	0	
	38	0	0	0	0	
	39	0	0	0	0	
	40	0	0	0	0	
	41	0	0	0	0	
	42	0	0	5	5	
	43	0	0	0	5	
	44	5	5	5	5	
	45	10	10	10	10	
	46	5	5	5	5	
	47	5	5	0	0	
	48	5	0	0	0	
	49	0	0	0	0	
	50	0	0	0	0	
	51	0	0	0	0	
	52	0	0	5	5	
	53	5	10	5	5	
	54	5	5	5	10	
	55	5	5	5	10	
	56	5	10	10	10	
	57	5	5	10	5	
	58	10	10	5	5	
	59	10	5	5	5	

460

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RECORD OF VISIBLE EMISSIONS

Company Name Tokyo Steel

Date 11-9-82

Plant Address [illegible], Japan

Observer MRB

Stack Location

Observer's Location 3

Weather Conditions scattered clouds
Wind - calm Background - sky

TIME						
HR	MIN	SECONDS 00	15	30	45	COMMENTS
461 16	00	5	5	5	5	
	01	5	5	5	5	
16 29 4 6 3	02	5	5	0	0	
	03	0	0	0	0	
	04	0	0	0	0	
	05	0	0	0	0	
	06	0	0	5	5	
	07	5	5	5	5	
	08	5	5	5	5	
	09	5	5	0	0	
471	10	0	0	0	0	
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
	19					
	20					
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					